COMBUSTION

DEVOTED TO THE ADVANCEMENT OF STEAM PLANT DESIGN AND OPERATION

September 1951

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Long Distance Hydraulic Pumping of Coal

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COMBUSTION

Editorials

Degrees and Honors

The British appear to be more concerned with degrees and honors than American engineers. At least they give more recognition of this sort in listing speakers for technical programs than is the case in this country. An example is the announcement of the General Discussion on Heat Transfer, a conference in London on September 11–13 arranged by The Institution of Mechanical Engineers and The American Society of Mechanical Engineers. The names of many of the British authors are followed by degrees (including the baccalaureate) professional society affiliations and any honors that may have been awarded. It is also of interest to note that the instructions for two of the social events that are a part of the conference call for "evening dress and decorations."

Evidently the British are accustomed to certain social amentities that are seldom practiced in American engineering circles. It is difficult to assess how much they contribute to sociability and friendliness at technical meetings. Perhaps they may make them more "stuffy." But in any case it is likely that we have something to learn from the manner in which engineering meetings are programed overseas.

Coal by Pipe Line

The recent study and report by the U. S. Bureau of Mines on the feasibility of transporting coal from mine to market by pipe line takes on new significance in the light of present economic conditions and the accumulation of more or less comparable experience.

The proposal, of course, is not new and has been applied in isolated cases over relatively short distances; but heretofore economic conditions and technological hurdles have precluded any serious attempt at long-distance transportation of coal by water in pipe lines. However, the present high rates for handling coal by rail constitute a large share of the delivered price in many localities, and there is reason to believe that they may increase further, whereas pumping costs estimated by the Bureau are in the competitive range. Furthermore, accumulated experience in the construction and operation of oil and gas line pumping over great distances, as well as in the handling of certain other bulk materials, should help to simplify the physical aspects of the problem.

True, as the report points out, more information is needed from pump manufacturers, but this is certain to be forthcoming should concrete proposals appear to justify the necessary research and development. The fact that a large coal company is planning a full-scale pilot installation to pump a mixture of finely ground coal and water a distance of several miles is promising to the proponents of the idea.

One might well conclude that economic considerations rather than physical limitations will provide the answer.

Iranian Oil

It was estimated by the Petroleum Administration that the oil crisis in Iran, up to the middle of August, had cut off more than thirty million barrels from world markets. This does not seem very large when compared with the present world usage of some ten million barrels a day, exclusive of Soviet-controlled areas, but it has been enough to dislocate the general pattern of supply and distribution. It means the diversion of appreciable supplies of Middle East and Caribbean crude from the East Coast refineries of the United States to European refineries, the deficit being made up by drawing upon domestic inventories.

This situation may be only temporary or it may drag out a long time, depending upon the final outcome of negotiations between the British and Iranian Governments. In the absence of an early solution, repercussions may be felt in the price of fuel oil in this country.

Fortunately, the coal situation here is at present stable with ample production assured, and most large boilers in the East are able to burn either coal or oil. The pendulum has already swung from the preponderance of oil firing of two years ago and is certain to swing further if the Iranian impasse continues.

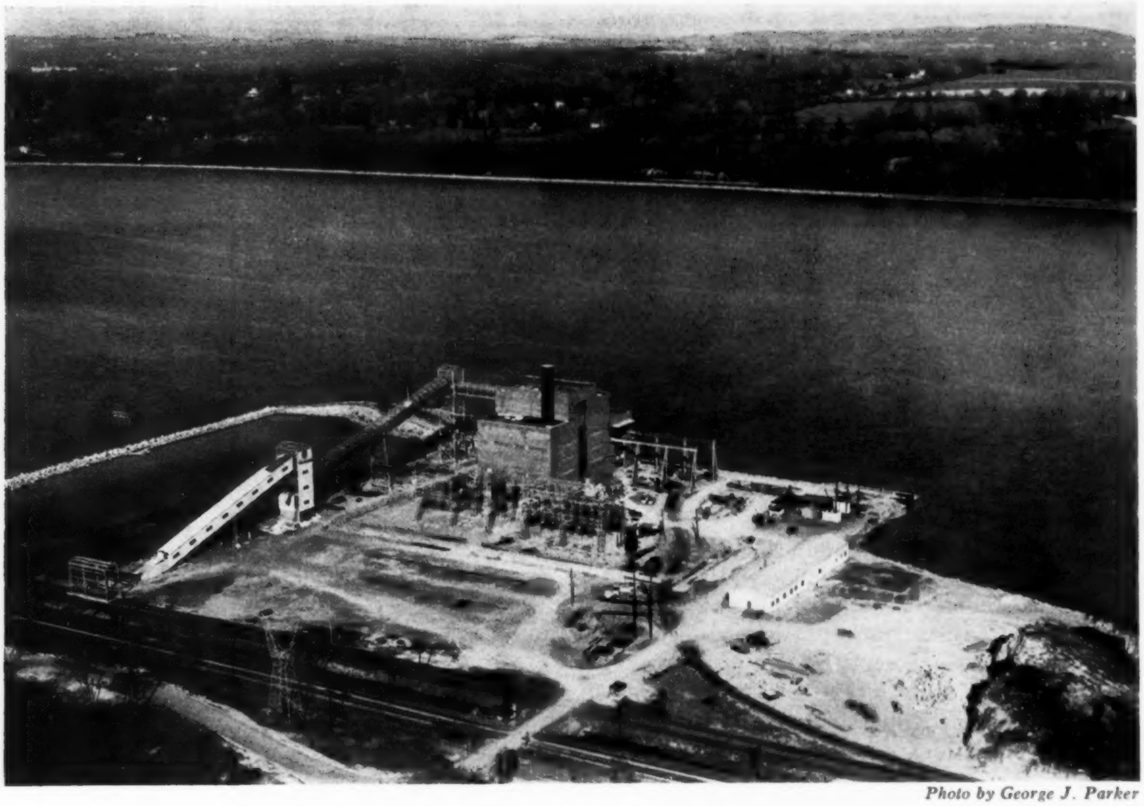


Photo by George J. Parker

View of station, looking across Hudson

Danskammer Point Steam Station Nears Completion

This article describes the first 60,000-kw reheat unit of the projected four-unit station which is now under construction at Danskammer Point on the west shore of the Hudson River a few miles above Newburgh, New York. The station is distinguished by its comparatively small building volume, a compact control room employing recently developed miniature instruments, and an unusually high feedwater temperature. Commercial operation is scheduled for January 1952.

CENTRAL Hudson Gas & Electric Corporation operates in an area of 2500 square miles in all or parts of eight counties along both sides of the Hudson River midway between New York City and Albany. In 1950 the peak load amounted to 135,000 kw. The present system started with the purchase of power companies in Newburgh and Poughkeepsie in 1900 and 1901. Danskammer Point Steam Station is the first major steam plant on the Central Hudson system, which heretofore has purchased about 80 per cent of its power and generated the remainder in its own hydro stations and a small steam station at Poughkeepsie. Interconnections are maintained with the Consolidated Edison Company of New York, Niagara Mohawk Power Corporation, the New Jersey Power & Light Company and the Connecticut Power Company.

Engineering Studies

Preliminary engineering studies were made to determine the best use of the Danskammer Point site and the optimum size of the initial installation. A number of arrangements were studied, all based on the use of single boiler-turbine-generator units. It was decided that the most satisfactory procedure would be to install initially one of two middle units of a projected four-unit plant. This arrangement lends itself to expansion in both directions. When a second central unit is installed, then the complete control bay for the entire station will be in place and located where it should be for the control of the ultimate station.

The following sizes of units were investigated:

1. 40,000-kw Preferred Standard turbine-generator.

2. 50,000-kw reheat turbine-generator with 25 per cent overload rating.
3. 60,000-kw reheat turbine with a 60,000-kw Preferred Standard generator.
4. 60,000-kw Preferred Standard turbine-generator.

From the viewpoint of pure economy of operation the total cost of power production was found to be the lowest for the 60,000-kw reheat turbine-generator which would go in service in 1952. Allowance for load growth to 1955 requires a capability of 120,000 kw; and it was determined that two 60,000-kw reheat turbine-generator units would have greater economy in operation than three 40,000-kw Preferred Standard turbine-generator units, assuming reasonable charges for power purchased by the Central Hudson system. Initial costs were also estimated to be lower for the two 60,000-kw reheat units.

Building Structure

The generating station and attached office building form a structure approximately 91 ft × 200 ft. The building heights vary from 36 ft for the office section to approximately 110 ft for the boiler room. The office section of the building is a three-floor structure, the general office area being located on the third floor. The first and second floors contain sanitary facilities, locker rooms, machine shops, test laboratory, the condenser cooling-water screen room and the chlorine water-treatment room.

Building volume, including boiler room, turbine room, office, and service building, is 1,448,000 cu ft. On the basis of turbine-generator nameplate rating this is 24.8 cu ft per kw, or 22.6 cu ft per kw of maximum turbine capability. As a result of mounting the turbine directly on the condenser and thereby cutting down the height of the basement, the building volume is about seven per cent less than in the conventional fully enclosed plant.

The station structure is supported by a combination of drilled-in caissons anchored into rock and piles. The caissons support the structural steel frame of the generating station proper, while the piles furnish the foundation for the service building. Both the caissons and piles are tied together with a reinforced concrete mat which supports the miscellaneous foundations in the basement. A sand cushion over this supports the basement floor.

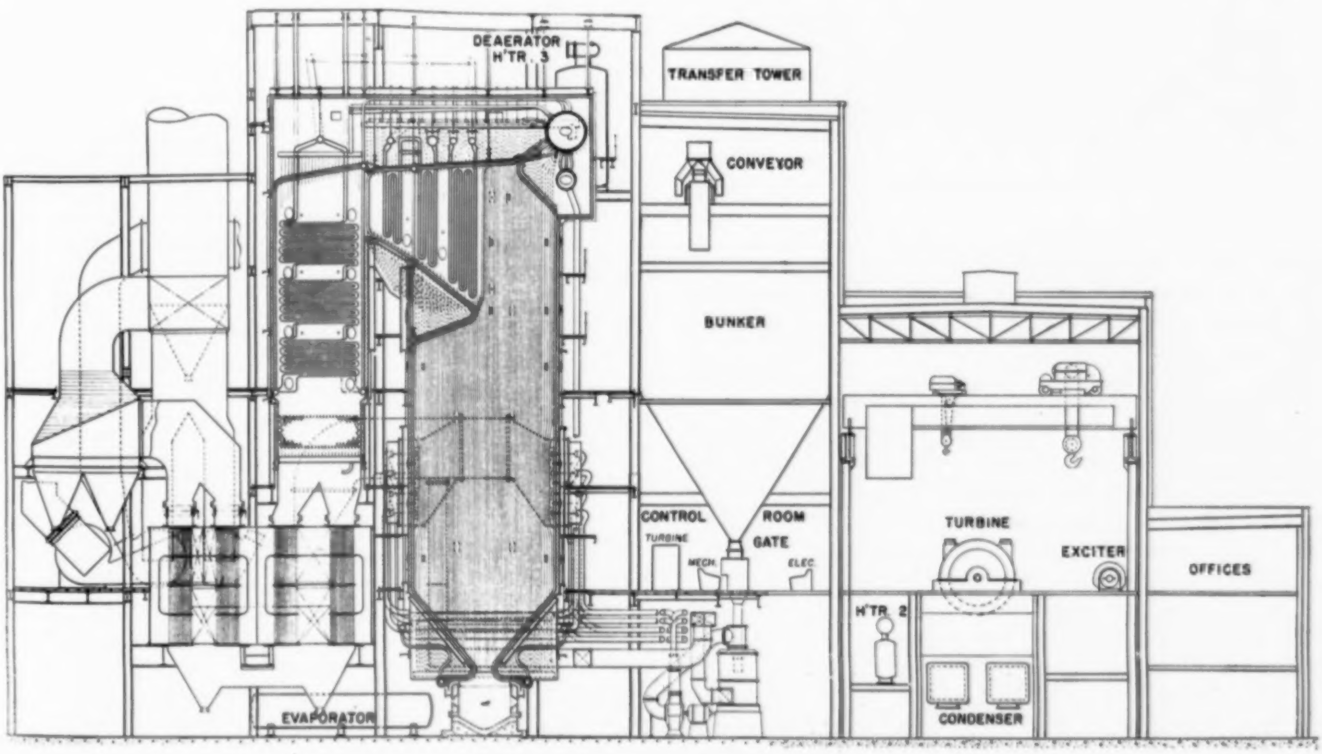
Exterior walls are of brick or terra-cotta tile. The east and west walls are of Hudson River brick, while the temporary north and south walls, which provide for future expansion, are made of terra-cotta tile.

Concrete with a red quarry tile finish is employed for the operating floor. The basement floor is concrete, while other floors above the operating level are of concrete or steel grating, as required. The floors of the service building and offices are concrete slabs finished in terazzo, quarry tile or asphalt tile, depending upon the intended service.

Glazed tile is used on the interior walls of the station, except for the temporary walls, and for the interior partitions of the office building. The roof is built of lightweight, pre-cast concrete slabs.

A pressurized ventilating system will maintain a positive pressure of 0.5-in. w. g. throughout the plant. With this system, air from out-of-doors is drawn into the building at the rate of 150,000 cfm by four aerial fans. The air is then delivered through inlet ducts to the forced-draft fans and into the boiler. Under rated conditions, this plant ventilating system provides 7.8 air changes per hour. The temperature rise at the operating floor is calculated to be 11.5 deg F above ambient.

The control room is air conditioned independently by a package unit, whereas the office building section is ventilated by a separate system which employs well water for cooling and dehumidification.

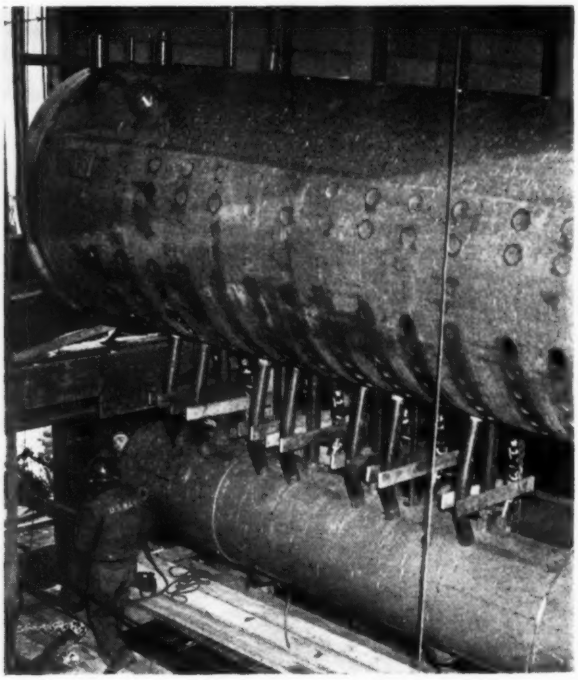


Simplified cross-section; boiler feed pumps not shown

Steam Generating Unit

The steam generating unit is a Combustion Engineering-Superheater radiant-reheat type with the reheater section located between the primary and secondary superheater. It has a fully water-cooled furnace and a basket-type bottom discharging to a sluicing ash hopper. A finned-tube economizer is located below the rear superheater section, and a tubular air preheater follows the economizer surface. The boiler is designed to be fired with either coal or oil by means of tilting tangential burners. Because of the unusually high temperature of the feedwater entering the economizer, 533 F when operating at maximum continuous rating, the steam generating unit has a very large superheater and a correspondingly smaller amount of evaporating surface.

Design pressure is 1840 psig, with superheater outlet conditions of 1700-psig, 1000-F primary steam and reheater outlet conditions of 470-psig, 1000-F reheat steam. The unit has a maximum continuous rating of 500,000 lb of primary steam per hour and 397,000 lb of reheat steam per hour. Under these conditions the furnace heat release is 22,500 Btu per cu ft per hr, and the calculated efficiency is 88.4 per cent.



Boiler drums with tubes in position for expanding

Four C-E Raymond bowl mills serve the boiler, each having a nominal capacity of 18,500 lb per hr when pulverizing 50 Hardgrove grindability coal with a maximum moisture of 10 per cent to a fineness of 80 per cent through a 200-mesh screen. The exhauster wheels for the mills are mounted directly on the driving motor shafts.

The Elesco two-stage superheater contains 38,414 sq ft of heating surface, while the interstage reheater has 6695 sq ft of heating surface. To protect the two-section tubular air preheater against corrosion at low loads, isolating dampers are provided so that either bank of the low-temperature section may be taken out of service. There is also provision for recirculation around the air heater from the hot-air outlet to the inlet of the forced-draft fan.

Diamond sequentially operated air-blowing soot blowers are being supplied with the steam generating unit, as well as Diamond Utiliscope television cameras for viewing furnace conditions and the water level in the boiler drum.

Steam temperature in the reheater is initially controlled by the tilting tangential burners. A thermocouple in the reheat steam line transmits an electrical impulse proportionate to the steam temperature to a bridge circuit. Any unbalance in this circuit is corrected by adjustment of the burner elevations to maintain correct steam temperature. When the tilting burners reach their lowest positions and further temperature reduction is required, a supplementary spray-type desuperheater provides the correction. An air-flow controller connected across a boiler pass anticipates changes in accordance with draft differential, due to load change, and repositions the tilting burners or reheat-desuperheater valve before the reheat temperature has changed enough to affect the thermocouple.

The temperature of the steam leaving the superheater is partially corrected by the tilting burners. A desuperheater is installed between the initial and finishing stages of the superheater, making it possible to reduce steam temperature if necessary. This desuperheater also operates in conjunction with a thermocouple in the primary steam line, an electrical bridge circuit and an air-flow anticipating controller.

Draft System

There are two forced-draft and two induced-draft fans, all manufactured by the Green Fuel Economizer Company. With the combination of one forced-draft and one induced-draft fan a little more than half of rated load can be carried by the steam generating unit.

Each of the forced-draft fans is rated at 68,700 cfm at 9.3 in. w. g. at 100 F and is driven by a 250-hp constant-speed motor. Volume control is by means of inlet louvre dampers. The rating of each induced-draft fan is 122,000 cfm at 7.0 in. w. g. and 335 F. Drive is by a 600-hp motor through an American Blower variable-speed hydraulic coupling.

A Prat-Daniel Valmont mechanical-type dust collector is located between the air-heater outlet and the induced-draft fan inlets. The collector, which has a high, narrow S-shaped gas inlet, has an efficiency of 90.5 per cent with the boiler at maximum continuous rating.

The induced-draft fans discharge vertically upward to the base connections on opposite sides of the Gunite-lined, self-supporting steel stack which extends 62 ft above the roof of the station.

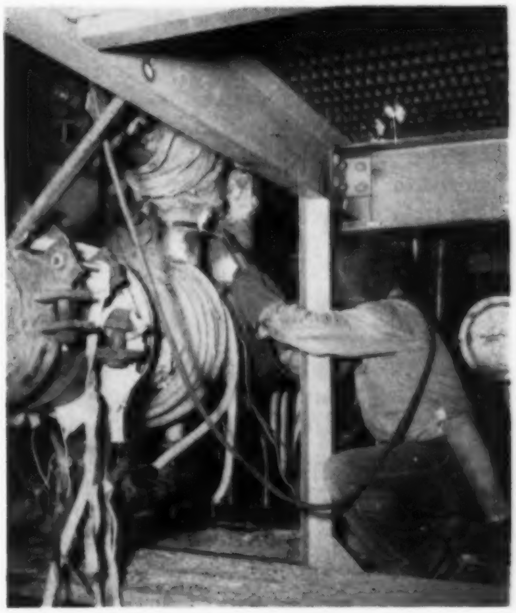
Turbine-Generator

The General Electric reheat turbine-generator is a 3600-rpm condensing machine with a nameplate rating of 60,000 kw and a maximum capability of 66,000 kw. The 24-stage turbine is of the tandem-compound, double-flow type and operates at throttle steam conditions of 1650 psig, 1000/1000 F and a condenser back pressure of 1 in. Hg. In accordance with General Electric practice for reheat machines, primary steam is admitted to the center portion of the high-pressure section and flows toward

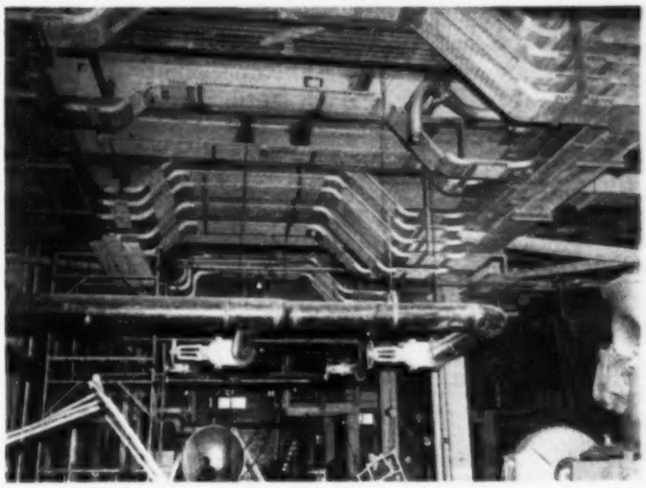
Four sections of condenser awaiting unloading at temporary station dock

Construction view of station and coal handling system

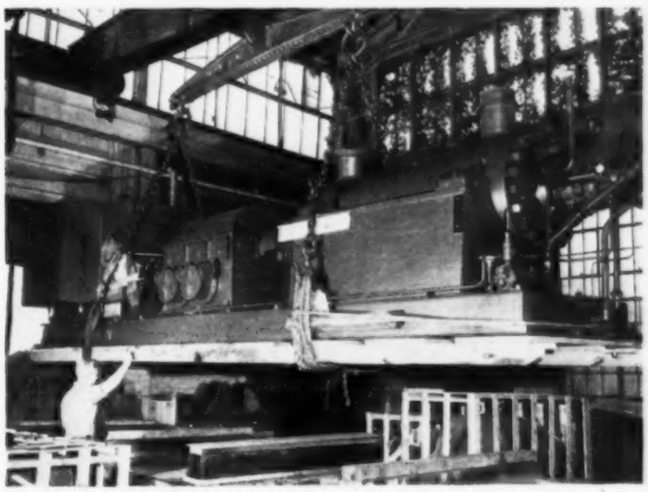
View from operating floor of heater No. 1 installed in throat of condenser



Welding main steam valve on the superheater outlet header



Installing cable trays under control-room floor; boiler feed piping suspended from ceiling



Barrel-type boiler feed pump ready for shipment from De Laval shop

the front end through seven stages before it is exhausted to the boiler and reheated. The steam then returns through two intercept valves to openings in the upper and lower halves of the center portion of the high-pressure turbine shell and flows through the remaining high- and low-pressure turbine stages to the condenser.

The generator is a hydrogen-cooled AIEE-ASME Preferred Standard machine. It is rated at 60,000 kw, 0.85 p. f., 70,588 kva, 3 phase, 60 cycles and 13,800 volts. Excitation is by a separate motor-generator exciter.

Condenser

As previously mentioned, the condenser serves as the foundation for the turbine-generator which weighs more than 500 tons and is the first ever to be constructed to support a unit of this size. It was built by Foster Wheeler Corp. in accordance with a design developed by Burns and Roe, Inc., for use in its Standardized Power Plants. A heavy frame fits on top of the condenser and acts as a cradle on which the turbine rests. Containing 46,500 sq ft of surface, the condenser is of the single-pass, reverse-flow design with divided water boxes. This permits cleaning of one half while the other remains in service.

The condenser, the largest of its kind ever built, was shipped to the site from Carteret, New Jersey, in four principal sections. Following a short rail transfer trip, the sections were loaded aboard barges and towed up the Hudson River directly to the station. Special rigging and reinforcement of the unloading dock were required to handle the 282-ton shipment.

For starting up a single-stage hogging ejector is provided to evacuate the condenser rapidly. Under conditions of normal operation a triple-element, two-stage steam-jet air ejector is used to maintain vacuum.

The Foster-Wheeler circulating-water pumps are of the vertical mixed-flow type mounted in a pit below the basement floor and projecting into the intake tunnel. The combined rating of the two pumps operating together is 42,000 gpm at a total head of 28 ft. One circulating pump alone will allow carrying about 60 per cent of full load on the turbine when the river temperature is 60 F.

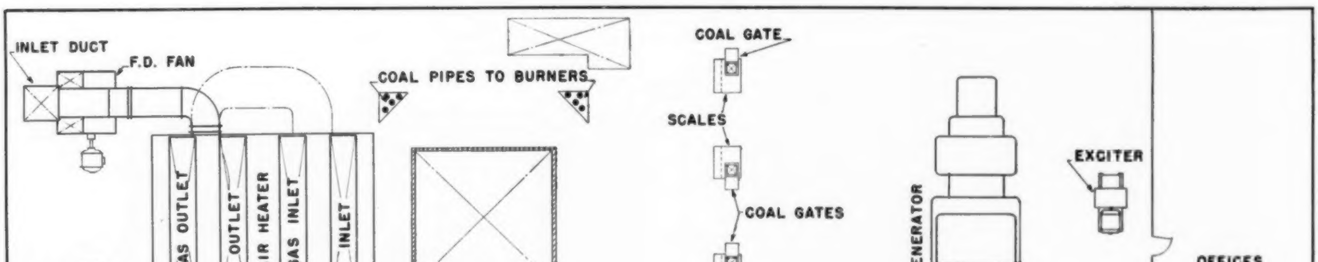
There is a 300-ft circulating-water line having a diameter of 84 in., which is one of the largest wrought iron pipes ever installed for this purpose. It was shop fabricated in sections by the M. H. Treadwell Company and installed by Drilled-In Caisson Company.

Feedwater Cycle

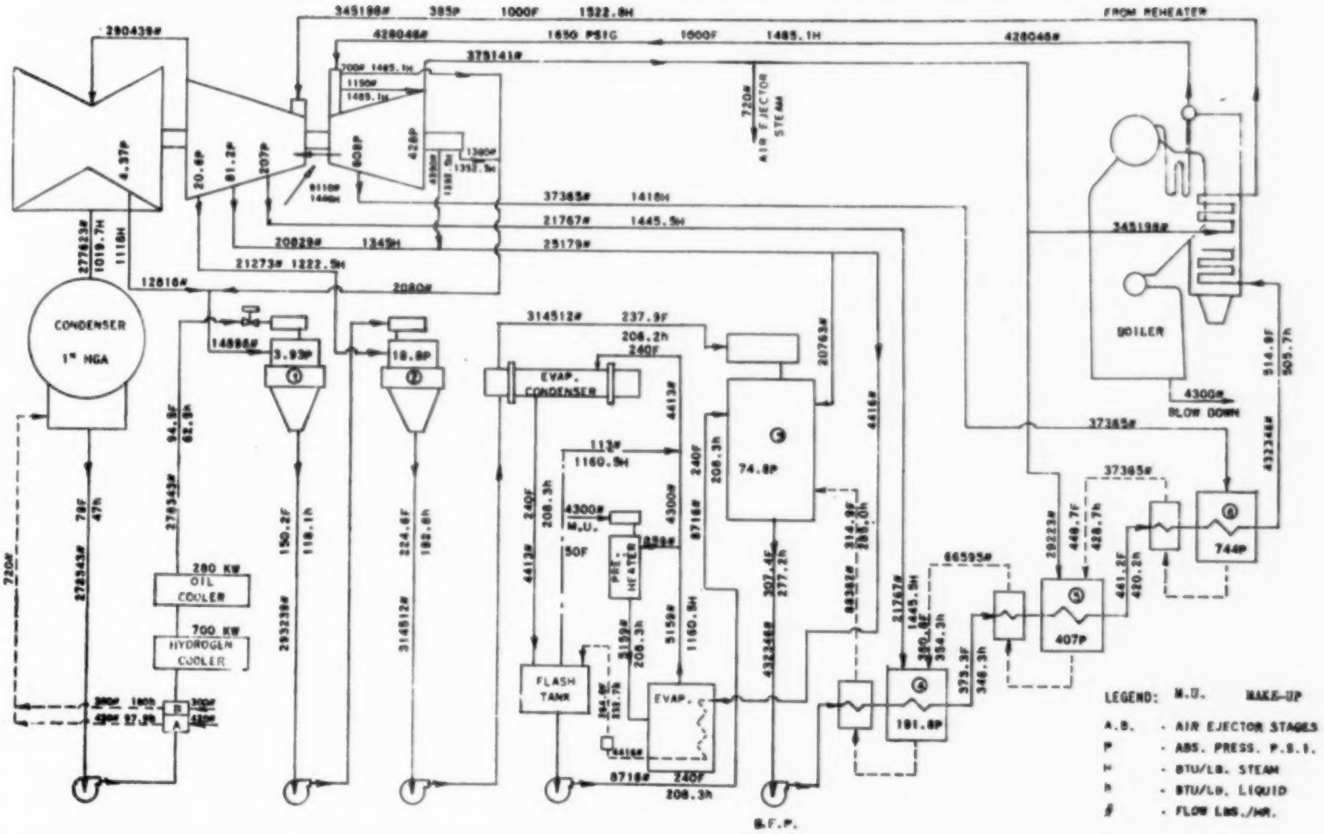
Steam is extracted from the reheat turbine at six points for feedwater heating. What is known as the Roe heater cycle in this instance is composed of two low-pressure direct-contact heaters, a vertical direct-contact deaerating heater, and a three-section vertical condensate pump. The most important feature of the Roe cycle is the multi-section pump which is designed with oversized sections in order to take care of swings and changes in the feedwater flow and to make allowance for pump wear. Under normal operation the first two sections handle a mixture of steam and water.

The vertical condensate pumps are of Foster-Wheeler manufacture and are installed in duplicate. The impeller eyes are positioned upward so that water can flow into them without being lifted and without pockets being formed in the connecting piping. Check valves are installed between the direct-contact heaters and the bleed line to prevent possible overspeeding of the turbine in the event of backflow resulting from loss of load.

The Roe cycle has several advantages over closed-heater cycles. Because of the absence of tubes in the low-pressure heaters maintenance is simplified. Since each heater picks up its own condensate, there are no cascading losses, and terminal difference is practically zero because of the mixing of the steam and water in the heater. The result is that there is a slightly greater amount of bleeding at lower pressures and a slightly higher thermal efficiency. In this case an unusually high temperature of the feedwater entering the economizer (515 to 533 F) is obtained by bleeding steam at a



Plan view of operating floor



Heat balance diagram with plant makeup

Gross load	60,102 kw
Turbine heat rate	7951 Btu/kwhr
Makeup	4300 lb/hr
Blowdown	4300 lb/hr
Auxiliary power	4088 kw
Boiler efficiency	88.7 per cent
Net output	56,014 kw
Net heat rate	9613 Btu/kwhr

pressure of approximately 800 psia from the high-pressure section of the reheat turbine to the sixth-stage heater.

As shown in the heat-balance diagram, the calculated net heat rate at turbine nameplate rating is 9613 Btu per kwhr. With zero makeup at the same rating the calculated heat rate is 9581 Btu per kwhr.

There are three Lummus high-pressure heaters in the cycle. These are of the closed, horizontal U-tube type, and each heater has an integral drain cooler. All of the high-pressure heaters are provided with shut-off valves and bypasses in the feedwater piping to allow for the inspection and repair of any heater.

The Cochrane deaerating heater is of the vertical direct-contact type having a large water storage tank. The two direct-contact, low-pressure heaters, the first of which is constructed internal to and integral with the condenser, are of Foster-Wheeler manufacture.

Two boiler feed pumps and two condensate pumps are installed, one combination of which is capable of supplying the unit at full load. The De Laval eleven-stage barrel-type boiler feed pumps are each rated at 1400 gpm against a head of 2170 psia and are driven through American Blower hydraulic couplings by 2000-hp motors. The Foster-Wheeler vertical multi-section condensate pumps each have a capacity of 399,600 lb per hr at 100 ft TDH in the first section, 399,600 lb per hr at 70 ft TDH in the second section, and 417,600 lb per hr at 306 ft TDH in the third section.

A Griscom-Russell evaporator capable of evaporating 22,000 lb of steam per hour is furnished. It is of the horizontal, submerged bent-tube design. The preheater for the evaporator is an Elliott vertical direct-contact deaerating heater.

Water Treatment

Makeup for the feedwater cycle is designed for four per cent to take care of all operating contingencies but is expected to be one per cent or less under conditions of normal operation. Water is obtained from wells located near the station. The well water, according to a typical analysis, has a total hardness of 284 ppm, expressed as equivalent $CaCO_3$, and a methyl orange alkalinity of 250 ppm. Before entering the evaporator the well water undergoes zeolite softening in a Belco system composed of a sodium zeolite softener regenerated by sulfuric acid, and a degasifier for removal of free carbon dioxide from the blended effluent of the softener. The effluents of the two zeolite softeners are mixed in such proportion that the alkalinity of the sodium zeolite neutralizes the mineral acids in the hydrogen zeolite, leaving a safe excess of alkalinity of 20 to 25 ppm in the final mixture. The degasifier limits the CO_2 to 15 ppm.

The concentration of solid matter in the softened water within the evaporator shell is controlled by blowdown regulated by conductivity readings of the concentrated water.

A small amount of sulfite is to be added to the boiler feedwater to absorb traces of residual oxygen after the water passes through the deaerating heater as well as any oxygen that may be entrained between the high-pressure heaters and the economizer. Caustic treatment is also provided to neutralize free CO_2 or other acids.

Secondary treatment of the boiler water will also be required. It will consist of the addition of soluble phosphates which will produce calcium phosphate, a soft sludge. Continuous blowdown will be used to regulate solids in the boiler water.

The Hudson River water used for condenser cooling will be subject to intermittent chlorination for control of organic slime in condenser tubes, piping and tunnels.

The consultant for water-treatment problems is Sheppard T. Powell of Baltimore.

Coal Handling

Coal will be received at the plant site via the West Shore Division of the New York Central Railroad. It will be unloaded into track hoppers provided with a grizzly to limit the size of run-of-mine coal lumps to 12 in. Two oil-fired thawing pits are being provided at the south side of the track hopper to thaw frozen cars during severe weather. These pits are located so that two cars may be thawed while a third is being unloaded at the track hoppers. A Hewitt-Robbins car shakeout has been furnished to speed up the unloading.

From the track hoppers the coal passes to Chain-Belt pan-type conveyers and then through a chute on to belt conveyors which elevate it to the top of the crusher house. A permanent-magnet type pulley separates tramp iron from the coal in advance of the ring-type crusher, which reduces run-of-mine lumps to $^3/_4$ in. or smaller. Provision is made so that the crusher may be bypassed. To select suitable samples for analysis, an automatic coal sampler and crusher is installed.

Yard storage is by means of a bulldozer and carryall. The initial storage area will be about 400 ft long by 210 ft wide, holding about 35,000 tons of coal. For reclaiming from yard storage the carryall and bulldozer will be used to push the coal into the track hopper.

From the crusher the coal passes to a transfer tower where it drops through a chute on to a conveyor, which carries the coal over the bunkers. An automatic tripper distributes the coal uniformly along the length of the bunker which has a storage capacity of 1500 tons, or enough for full-load week-end operation. The bunker is sealed off from the building to reduce dust nuisance. From the bunkers the coal flows to the pulverizers through Richardson scales.

Future delivery of coal by water has been studied and provision may be made to add an unloading tower on the river front and to construct an additional conveyor to transport the coal to the crusher tower.

Ash Handing

Ash from the dry-bottom furnace falls into an Allen-Sherman-Hoff collecting hopper lined with a monolithic refractory cement and flooded with water. A water-filled Corten steel trough is located at the top of the hopper and forms a water seal between the water-wall headers and the ash hopper. The latter has a twenty-hour storage capacity. The ash is to be transported hydraulically to an area at the northern end of the station where it is to be used for fill to make an enlarged coal storage area.

Fly ash collected from hoppers under the air heater and tubular dust collector, and at the base of the stack, is also mixed with water and discharged to the fill area.

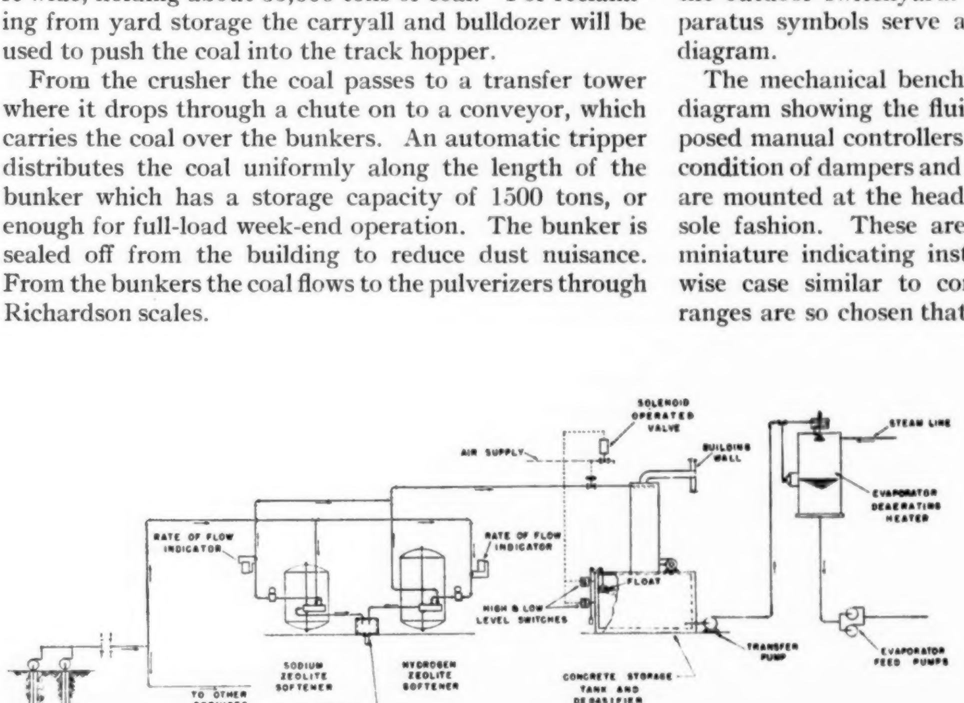
Centralized Control

A sound-proof, air-conditioned, glass-enclosed central control room has as its primary function the direct supervision of the power cycle. Ultimately four complete boiler-turbine-generator units will be controlled from this room which, in keeping with the comparatively small cubic size of the plant building, has proportionately limited space.

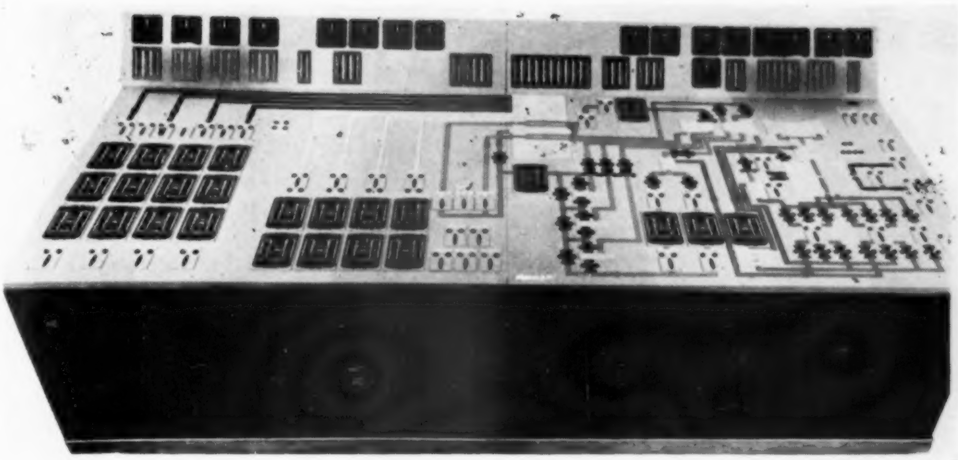
Control of all the principal auxiliary equipment is within the direct supervision of the central operators. In the control room the 60,000-kw unit will be manned by two operators. Jointly they will control the generator and electrical system, as well as the boiler, turbine and related auxiliaries. An electrical benchboard, a mechanical benchboard, a vertical control board for recording instruments and an operator's desk are provided.

The electrical benchboard controls the generator, the generator excitation, the generator step-up transformer, station auxiliary transformer and the 115-kv breakers in the outdoor switchyard. Mimic buses with proper apparatus symbols serve as a miniature one-line station diagram.

The mechanical benchboard embodies a colored flow diagram showing the fluid cycle, on which are superimposed manual controllers and a set of lights showing the condition of dampers and valves. Indicating instruments are mounted at the head end of the benchboard in console fashion. These are a new type of Bailey Meter miniature indicating instruments mounted in an edgewise case similar to conventional draft gages. Scale ranges are so chosen that when the unit is running norm-



Flow diagram of evaporator feedwater system



Mock-up of mechanical benchboard showing use of miniature Bailey indicating instruments

ally an unbalance in the cycle can be readily detected by a horizontal sweep of the eye which would pick up a pointer deviating from the normal position.

The vertical control board is a duplex-type cubicle having instruments mounted on both the front and rear panels. The front face contains turbine supervisory instruments; recording instruments for the combustion control, drum-level control, and No. 3 feedwater-heater-level control systems; a Diamond Utiliscope boiler drum-level indicator; and an annunciator panel containing alarm relays for both mechanical and electrical equipment. On the rear face there are mercury gages, bleed-steam pressure recorders, feedwater-heater temperature recorders, steam-temperature recorders, a conductivity recorder and a boiler gas-temperature recorder.

The annunciator panel, fabricated by the Kirkland Co., overcomes some of the limitations of conventional annunciators with which it is often difficult to distinguish between faults that have just come in, those that have been acknowledged and those that have been corrected. When an equipment fault occurs, a horn is sounded and a particular window is illuminated by internal red and white lamps. After acknowledgment by the operator who throws an individual toggle switch, the white light is extinguished, but the red lamp remains on until the fault is cleared. At this time a bell sounds, cutting out the red lamp and illuminating the white lamp. The operator then acknowledges this, silencing the bell and leaving the window dark.

The Bailey Meter combustion control system is basically a metering type control which holds the steam pressure, the steam flow–air flow ratio and the furnace draft to predetermined values. Pulverized coal flow is regulated by positioning the bowl-mill exhauster dampers and regulating the variable-speed drives of the feeders to the four pulverizers. The speed of the induced-draft fans is varied by the hydraulic coupling scoop tubes which are positioned through loading pressures obtained from the boiler meter controller. When changes in air flow upset the balance of the furnace draft controller, it is restored by repositioning the inlet dampers of the forced-draft fans.

Most of the instruments and controllers are pneumatically operated, and no high-pressure lines are brought into the central control room. To eliminate difficulties caused by oil in control lines, the air compressors for the control systems are equipped with carbon piston rings.

Electrical System

The 13.8-kv generator voltage is stepped up directly to the 110-kv transmission voltage with no intervening breaker. Normal auxiliary power is obtained from a 13.2/2.4-kv transformer supplied at generator voltage with disconnecting links in the 13.8-kv supply. Connections between the generator terminals and the generator step-up transformer and protective equipment are made with 13.8-kv metal-clad, isolated-phase bus duct. Overhead conductors are used to connect the generator step-up transformer and the high-voltage switchyard and transmission lines.

Auxiliary equipment is operated at 480 and 2400 v. With the exception of the 100-hp generator emergency auxiliary oil-pump motor, all motors of 100 hp and larger are supplied at 2400 v. Smaller auxiliary motors are operated on 480-v circuits. The essential auxiliaries have been so arranged as to power supply that failure at a bus section cuts only duplicate auxiliaries from service.

Future Units

As was mentioned earlier, ultimate plans are to construct a four-unit station. The second unit is to be a 60,000-kw extension to the north substantially duplicating the present installation. According to present plans commercial operation of the second unit is scheduled for August 1954. The third and fourth units will be located to the south of the present construction and will likely have nameplate ratings of 80,000 kw.

Burns and Roe, Inc., are serving as consulting engineers and are supervising construction. The principal contractors for the first unit are G. D. Campbell Company, superstructure; Drilled-In Caisson Company, substructure; The M. W. Kellogg Company, piping and mechanical installation; M. H. Treadwell Company, boiler and turbine erection; and Hatzel & Buehler, electrical installation.

Acknowledgment

We wish to express our appreciation to the combined staffs of Central Hudson Gas & Electric Corporation and Burns and Roe, Inc., for the information and data on which this article was based and the authorization to publish the article in COMBUSTION.

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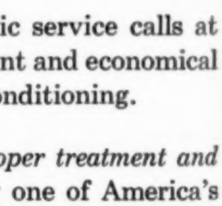

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Long-Distance Hydraulic Pumping of Coal

Digest of a report covering a study by the U. S. Bureau of Mines reviewing what has already been done along this line, giving pumping cost estimates and concluding that for large tonnages the plan is economically competitive. One large coal company is now planning a three-mile demonstration plant in Ohio.

THE proposal that coal be transported hydraulically from mine to market is not new, but heretofore certain more or less superficial studies have failed to show its economic justification, even though the physical problems might be surmounted. However, with railroad freight rates ever increasing and the experience gained through long distance oil and gas line transmission available, the time may be ripe for giving further attention to the idea as concerns large tonnages.

This has now been done in a preliminary way, as shown in a report (No. 4799) just published by the U. S. Bureau of Mines under title "A Survey on the Hydraulic Transportation of Coal," by R. W. Dougherty. It contains a large amount of information on the subject and points the way to further studies based on much-needed pump performance data.

Following a brief review of what has been done along this line in the past, including an extensive bibliography of published literature, the report cites the opinions of certain pump manufacturers and then proceeds with the results of an economic study. Conclusions are that the idea is economically feasible for large tonnages at continuous load.

About 1895 a U. S. patent, broadly covering a method of pumping coal with water through pipe lines, was granted to W. C. Andrews whose process was used to some extent in pumping anthracite culm and waste back into the worked-out portions of the mines. Ten years later a patent was granted W. T. Donnely on pumping anthracite silt away from the breakers.

Some time later, from 1913 to 1924, a British engineer by the name of Gilbert G. Bell used a short pipe line to convey coal with water from barges on the Thames to one of London's electric generating stations. In this case minus 5-in. coal was pumped 660 yd through an 8-in. pipe.

In making the present survey it was assumed that the coal would have been processed to remove most of the abrasive impurities prior to pumping, and that dewatering at the discharge end of the line would be considered part of the conventional cleaning operations.

Limitations

It is recognized that coal distribution by this means to other than very large users would not be changed, although power plants and large industrial users could be supplied directly through branch lines. Large storage areas would be required to supply seasonal markets, and pipe lines might not be able to carry a full range of sized coal to meet various market demands in some sections.

Furthermore, maximum economies of pipe-line transportation could be achieved only by moving large tonnages on a continuous basis, because of the high fixed charges.

By way of precedent, it is pointed out that sand pumps are employed for the transfer of solids by water in mining, dredging and certain other industrial operations such as phosphate matrix from the mines to the washing plants. Moreover, many coal-washing plants pump waste material to the refuse dumps, and one mining company is considering pumping coal from a new mine to the washer. Economy and trouble-free operation are reported.

Views of Pump Manufacturers

The problem of hydraulic transportation of coal was discussed with several manufacturers of centrifugal sand pumps, and all felt that coal could be handled economically by pipe line, provided adequate design and performance data could be obtained from laboratory and large-scale tests. Hydraulic heads not to exceed 800 ft for each pumping station were recommended because packing seals have not been developed to perform satisfactorily above that pressure. It is believed that four single-stage pumps in series would develop the required head for normal operation at each pumping station. Pumps of special design, capable of maintaining higher head pressures would reduce the number of pumping stations. For finely ground coal reciprocating pumps were thought to offer possibilities if specifically designed for that purpose.

Pumping stations could be controlled from one or more master stations and might copy recent oil pipeline practice which employs control by microwave radio.

Pump manufacturers were found not to be in agreement as to the percentage of coal by weight that might be pumped most readily and economically. Opinions ranged from 25 to 40 per cent, and it was obvious that the optimum ratio for a given top size and screen analysis could be determined only by test. The maximum amount of fines (through 100 mesh) that are marketable is desirable as they tend to lubricate the mixture and lessen the power required.

It developed that Westinghouse Electric Corporation has been able to keep fine coal in suspension and has pumped coal-water slurries with greater than 1:1 ratio. Also, the Standard Oil Company (Ohio) found that fine coal-water slurries up to 35 per cent coal by weight pumped as readily as water, with about the same

viscosity at 3 to 5 ft per sec linear velocity. Furthermore, no line plugging was experienced when the line was shut down overnight or on week ends. In general, the smaller the top size, or the finer the material, the lower the linear velocity required to keep the coal in suspension.

In this connection, the Morris Machine Works has determined experimentally that the critical velocity for 2- to 3-in. top size solids is 7 to 9 ft per sec in an 8-in inside diameter pipe; and a safe velocity is 10 to 12 ft per sec. For a 10-in. pipe the critical velocity was 8 to 9 ft per sec and the safe velocity 11 to 13 ft. This manufacturer believes that $^3/_{16}$-in. top size could be pumped successfully through a 3-in. line at a velocity of 5 ft per sec.

Pumping Cost Estimates

Estimates of pumping cost by one reliable pump manufacturer ranged from 2.4 cents per ton-mile for conveying 500 tons per 8-hr day to 1.8 cents on a 24-hr basis. This does not include fixed charges.

The survey points out that accurate predictions concerning installation and operating costs involve such factors as size and shape of the largest particles, screen analysis, size of line, actual linear velocity, weight of solids per unit of volume, gravity of solids and mixture, erosion of pipe line and pumps, degradation of coal and pressure drop in line; also, such questions as water rights, pipe-line right-of-way and the type of construction.

While it is apparent that detailed estimates of pipeline costs cannot be prepared without extensive pump-performance data on handling given screen-analyses coals, sufficient information was available to permit preliminary estimates, including 50 per cent pumping station spares, right-of-way, piping materials and construction, operating labor, water cost, power and taxes, with capital charges of $18^1/_2$ per cent on the total investment. These for a 100-mile level pipe line are summarized as follows:

Coal, tons per day	Construction cost, millions	Transportation cost \$ per ton—100 miles
5,000	9.3–10.1	1.28–1.91
7,000	10.3–11.9	1.09–1.77
12,000	12.3–14.0	0.73–1.24
24,000	16.4–19.1	0.50–0.88
36,000	18.9–25.7	0.38–0.95

Conclusions

From the information available, the report concludes that coal may be transported economically in pipe lines, especially in large tonnages, to supply a steady industrial market. However, before such a line can be built much more actual pump-performance data must be accumulated and information on the probable erosion of pipe and pumps, the degradation of coal, the most economical linear velocities, and the pressure drop in lines must be determined accurately for each coal mixture.

As an addenda, it is mentioned that the Pittsburgh Consolidation Coal Company plans to build a full-scale demonstration pipe line near Cadiz, Ohio. This will be of 12-in. pipe and will be 17,000 ft long. Finely ground, minus $^3/_8$-in. washed coal will be mixed with water and pumped through the line on a continuous basis.

*Studies of Stack Discharge Under Varying Conditions**

By W. F. DAVIDSON

Research Engineer, Consolidated Edison Co. of New York

Discussed are the influence on effective stack height of such factors as exit gas velocity, gas temperature, shape of stack top, the presence of nearby structures and meteorological conditions. The problem encountered in designing stacks for the new Astoria Station in New York City is reviewed.

STACK design, as the term is used here, is concerned not only with the height and diameter of the stack, but also with the effective height which may be increased by suitable changes in the shape of the top of the stack and by increasing the exit velocity of the gases. It considers the effects of nearby structures, and particularly those features which have an influence on the airflow pattern near the stack. It considers the influence of the temperature of the stack gases.

Stack design is concerned chiefly with what may be called the aerodynamic factors of air flow, in distinction from meteorological factors, as the former are factors over which the designing engineer may have some control. The meteorological factors must be accepted as they come, but they cannot be ignored.

We begin, therefore, with a consideration of that part of the plume of discharged stack gases which is the least influenced by aerodynamic factors and the most influenced by meteorological factors, namely, the part distant more than about ten times the stack diameter from the stack.

Several investigators, principally in Great Britain and notably Bosanquet and Sutton, have developed mathematical methods for computing the concentration of particulate or gaseous pollutants in the atmosphere at points some distance from the source. These have proved accurate enough for many analyses for "normal" atmospheric conditions when the terrain is reasonably level and there are no large disturbing structures. For other cases, as when there are strong "inversions" or where there are large structures in the path of the plume, the computed absolute values of concentration may be in considerable error, but the relative values may well be accurate enough to permit making an acceptable evaluation of two or three alternative stack designs.

In each case the analysis assumes that the plume behaves as though it came from a point source higher than the actual top of the stack and displaced upwind from it. One of the aims of stack design is to make the height of this virtual source—the "effective height" of the stack—as large as practical, the more so because in the general case the concentration of pollutants will decrease inversely as the square of the effective height. A 10 per cent increase in stack height means about a 20 per cent decrease in concentration. In some cases, one of which will be discussed later, the increase in effective height may be important because it is sufficient to raise the plume so that it no longer gets trapped in a backwash or downdraft caused by a building or other structure.

Influence of Air Movement

Papers describing details of these mathematical analyses are listed in the bibliography. There are, however, some characteristics of the natural air movement which must be clear before one can understand some of the problems of stack design. The usual description of a wind as of so many miles per hour from such a direction is far from being adequate. For one thing, the stated speed and direction are based on observations made at a particular site and elevation; the site may be satisfactory but it will be little more than a coincidence if the elevation is that of the top of the stack where it is essential to know the speed. In most cases it will be possible to make an adjustment of the observed speed which will be accurate enough. Sailors and aviators are accustomed to adding a further descriptive term which is needed; they refer to a wind as "steady" or "gusty" or some other descriptive term. A quantitative measure, rather than purely descriptive term, is needed if mathematical analyses are to be used. However, in any case, these terms call attention to the fact that the wind is not a steady stream-line flow, but is more nearly the sum of a steady stream-line flow that changes slowly and a number of eddies or vortices of a wide assortment of sizes and frequencies. In a steady wind over the plains or large areas of water on cloudy days, the turbulent part of the flow is small and a smoke trail will travel long distances before it finally becomes so diluted and diffused that it can be seen no longer. The other extreme is most likely to be found over rough terrain (either natural or man-made, as a city) on a bright sunny day with a few scattered clouds. Then diffusion is rapid and the smoke trail loses its identity.

However, the natural turbulence just discussed is not the only kind of turbulence that concerns the problem. In natural turbulence the centers of the eddies seem to move along at about the speed of the wind, just as smoke rings drift along. In the other form of turbulence, only a few eddies or vortices are formed and these seem to remain almost stationary in space as though attached to the obstacle that caused them to form. These are the familiar downdrafts and backwash, and one aim of stack design is to reduce or eliminate them.

* Presented at the Fourty-Fourth Annual Convention of the Air Pollution and Smoke Prevention Association of America, Roanoke, Va., May 6–10, 1951.

The effect of inversions on the diffusion of waste gases discharged from stacks has received so much attention that the causes and general characteristics of inversions need not be discussed here. About the only time where stack design alters the case for the better is to be found when the effective stack height is such that the stack or the jet penetrates an inversion ceiling. Whether such cases occur frequently enough to be a significant factor can be determined only after careful analysis of a particular situation.

While it may be taken as self-evident that increasing the average velocity of the gases as they are discharged from the stack will increase the effective height of the stack, the engineer must have some measure of the improvement in order to determine the best new design. This is doubly important because added velocity cannot be obtained without an increased pressure drop, and this means more fan power. Investigations in this direction were made by Sherlock and Stalker (6) as reported in 1940, and by von Hohenleiten and Wolf (9) as reported in 1942. In each of these investigations, scale models of the power station and stacks were tested in a wind tunnel, but it is not easy to use their data and conclusions in other problems because of the unknown effects of turbulence created by the buildings which are not readily isolated from the effects of minor change in form of the top of the stack. More recently Bryant's work at the National Physical Laboratories in England (3) provides very helpful data obtained in wind-tunnel tests of a simple stack isolated from the effects of localized turbulence.

Wind-Tunnel Studies

Within the past year studies of almost twenty variants of five types of nozzle or stack top have been made in a special wind tunnel at New York University under the direction of Prof. G. H. Strom. A technical paper based on the results is in preparation, and it is hoped that it will be published in the near future. In these studies a single isolated stack was used, so that the observations are not influenced by the particular design of the power station buildings. The data bring out major differences in the effectiveness of different nozzles. The most important factor seems to be the uniformity (or lack of uniformity) of the gas velocity across the orifice. The more the uniformity the greater is the increase in effective height of the stack for a particular average velocity. Another factor is the influence of the external shape of the top of the stack as presented to the wind. Shaping the outline of the stack to hide an internal nozzle is always detrimental, and camouflaging it as a building is even worse. The increase in effective height of the stack is about 25 per cent greater when the stack is fitted with a semi-elliptic stream line nozzle instead of having a conventional stack shape, the average exit velocity being the same in both cases.

The nozzles studied in the tests just mentioned included two that were arranged so that the orifice area could be changed by closing or opening suitable dampers as a means for increasing or decreasing the average exit velocity corresponding to a particular mass flow. In one design a cylindrical tube of about $1^1/_2$ stack diameters in length was inserted in the top of a conventional stack with dampers to close the annular or the central opening. This arrangement gave very poor performance. In the other design both the inner and the outer tubes were of semi-elliptic cross section. This arrangement gave very good performance.

Increasing the temperature of the stack gases has only a slight influence on the effective height of the stack. However, in some circumstances the increased buoyancy may significantly raise the trajectory of the plume at considerable distances from the stack. Probably the best basis now available for calculating the magnitude of the benefits from higher temperature is that given in a recent paper by Bosanquet, Carey and Halton (2).

In the preceding discussion it has been assumed that the exit gas velocity was at least as large as the wind speed, because at lower velocities the turbulent wake on the downstream side of the stack may bring the lower boundary of the plume below the top of the stack. But there is another type of turbulence which may be far more objectionable. It is the large eddy or downdraft created by nearby structures and particularly the power station. This has been recognized for a long time and has led to a "rule of thumb" to the effect that the height of the stack should never be less than $2\frac{1}{2}$ times the height of the power station. Despite the importance of this factor, except for stacks of limited height and the number of investigations made, it is still impossible to give any rules or criteria that can be used with reasonable assurance to predict the stack performance of a new station. Carefully planned wind-tunnel tests seem to be required. In some cases the conditions may be so unfavorable as to defy corrective measures but more frequently it is possible to make changes which will result in major improvement even if a completely satisfactory solution is not found. The most common troubles seem to have their origin in turbulence created by some sharp corner on the building which is in such a position relative to the stack that the turbulent wake which it creates passes close to the top of the stack. When this occurs it may bring to naught the efforts to increase the effective stack height by careful stack nozzle design.

Before the stack design features can be evaluated it will be necessary to have adequate meteorological data, particularly as to the frequency and duration of winds of particular speed and direction. It is scarcely possible to have too much such data; the usual experience is not to have enough and to be forced to make generalized assumptions without being able to estimate their reliability. The services of an experienced meteorologist are almost always very helpful in such situations.

The Problem at Astoria Station

By way of illustration to show how the elements of stack design fit into the general design of a large power station, some of the novel features of the new Astoria Station in New York will be discussed.

The site for the station is about 2 miles west of LaGuardia Field at the westerly end of a large plot which forms a point on the east side of the East River. A small inlet forms the eastern boundary of the plot, hence there is water on three boundaries. Somewhat more than half the plot is used for gas manufacturing facilities and coal storage. The only nearby residential area lies immediately south and southwest from the power station site. The houses are two-, three- and four-story multiple dwellings and are comparatively new. South of the power station site, and directly between it and part of the residential area are two large gas holders about 270 ft high.

There would have been no unusual air pollution problems if there had not been a stringent limitation on stack height, for there was ample room at the site for the installation of precipitators and dust collectors and tall stacks would have kept the plume high at all times. It was only after extended discussions with representatives of the Civil Aeronautics Authority, the New York Port Authority, and New York City officials, and a shift of the plant site to place it farther from the approach zone of one of the airport runways, that permission was granted to build stacks 300 ft high.

Before the general planning had reached this stage it had been recognized that very careful study would have to be given to the stack design. Parts of the study were placed in a research project which was arranged with New York University on a basis that would assure bringing to the project not only the experience of the Department of Aeronautical Engineering, which would have the general supervision of the building and operation of a special wind tunnel, but also the experience of the Department of Meteorology.

To facilitate the somewhat extensive analyses of meteorological data, a set of Hollerith punched cards recording the observations at LaGuardia Field over a period of several years was purchased from the weather bureau. The data on wind direction and speed were analyzed for frequency and duration. Data on visibility were studied in the hope that they would give some basis for estimating the frequency of inversions, but it was concluded that little help could be found there. Considerable time was spent in studying the extensive data being collected at the Brookhaven National Laboratory on Long Island about fifty miles to the east. This effort was only moderately successful, for it became clear that the differences between conditions not far from the center of New York and those near the center of Long Island were so great and so little understood as to make arguing from one to the other not much more than an interesting diversion.

By the time the wind tunnel had been completed and put through its preliminary testing schedule, the meteorological studies and field surveys were far enough advanced to provide a good basis for determining the wind conditions to be assumed in the model testing program. It was reasonably clear then, and it was soon taken as fact, that the difficult requirements to be satisfied by the stack design were those which occurred with a north wind, for it was then that the plume would pass into the zone of turbulence created by the gas holders. If the effective stack height could be made sufficient to prevent the plume from being drawn down to the ground on the downwind side of the holders, it would be fully adequate under the conditions with other winds.

However, it seemed desirable to study first the influence of major alterations in the shape of the power station buildings without introducing the additional complications of nearby structures such as the gas holders. The tests in this series emphasized, as had been expected, that the sensitivity of the pattern of the plume to building shape varied greatly according to the wind direction. For some wind directions the minimum stack gas velocity needed to keep the bottom of the plume at least 100 ft above ground could be changed by a factor of 2 or more by "stream-lining" the buildings. It was a fortunate circumstance that, when the gas holders were introduced into the model, it was found that building modifications had comparatively little effect, and that in every case a stack gas velocity four times the wind speed was required to keep the plume 100 ft above ground level. Since the meteorological studies had led to selecting 30 fps as the highest wind speed at which the plume would be kept at least 100 ft above ground, the stack gas velocity should be at least 120 fps if the stack had a conventional top and if it were 20 ft in diameter. When adjustments were made to take into account the better performance of a semi-elliptical nozzle and the offsetting effect of a smaller orifice (equivalent to 16 ft diameter instead of 20 ft), the final design goal was still 120 fps. This would be necessary at any load from full down to half or for an operating range of 2:1. However, the wind would be in the critical direction only a little more than 10 per cent of annual hours and for most of the other 90 per cent of the time 60 fps would be high enough. As this would reduce fan power requirements by more than 200 kw, the possible savings were considerable.

After studying several suggested arrangements, two features new to power stations were selected. One is the use of an adjustable nozzle of the semi-elliptic type with an inner tube, also of semi-elliptic shape, which can be shut off by a butterfly damper so as to reduce the orifice area and double the velocity corresponding to any particular gas flow. The dimensions are such that when the unit is operating at full load, the gas velocity can be either 60 fps (when the damper is open) or 120 fps (when the damper is closed). At minimum load of the unit, the velocity can be either 30 fps or 60 fps. The second feature is for the purpose of increasing the latter figure to 120 fps when necessary. This is the installation of a duct with a continuously adjustable damper as a bypass around the boiler to carry air from the forced-draft fan outlet to the base of the stack. In this way the flow in the stack can be kept to that figure corresponding to full load on the unit, regardless of the actual load. Although this involves some losses due to throttling that could be avoided by the use of a separate fan discharging directly into the base of the stack, the expected use is so small that the annual energy saving is not enough to justify the additional equipment.

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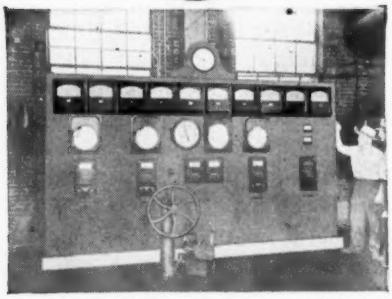

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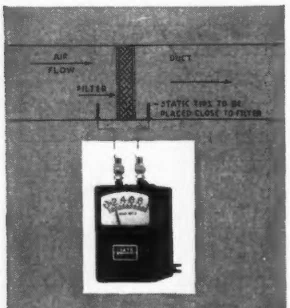

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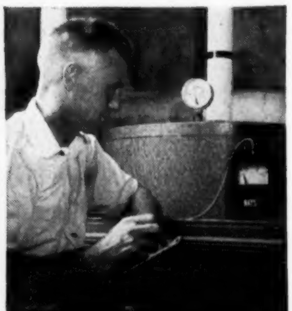

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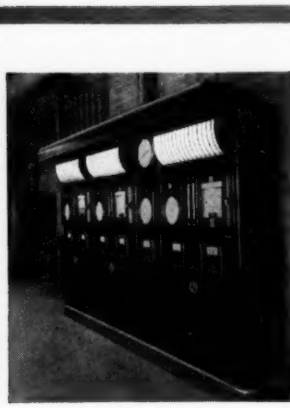

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Combination Flow Suggested for Regenerative Air Preheaters

Metal temperature at the cold end is an important factor in condensation and corrosion. Since this temperature is lower with counterflow, a combination of counterflow and parallel flow is suggested with the gas section divided, and the ratio between counterflow and parallel flow surface such as to obtain optimum metal temperature at the cold end.

LOWER exit gas temperatures accompanying increased boiler efficiency, and the wider use of inferior coals containing appreciable amounts of sulfur, tend to promote corrosion at the cold end of air preheaters, particularly at partial loads. That is, the corrosion can result both from moisture due to cooling the gases below their dewpoint and from the sulfuric acid formed from sulfur trioxide in the presence of moisture.

Various methods have been employed to raise the cold-end metal temperatures, such as taking the cold air from the top of the boiler room, hot-air recirculation, bypassing part of the cold air around the air preheater or bypassing flue gas at the economizer.

The usual arrangement with the regenerative type air preheater is to employ counterflow of flue gas and air, although by changing to parallel flow the temperature of the metal at the cold end can be increased at a sacrifice in economy and a decrease in hot-air temperature. However, the metal temperature at the cold end would be increased far above the dewpoint, the exit-gas temperature would be unnecessarily high and the hot-air temperature much reduced; all of which adds up to lower boiler efficiency. This is shown by curves in Fig. 1-b.

Another method has recently been suggested for increasing the metal temperature at the cold end of the regenerative rotary air preheater to a desirable but not excessive degree and thereby avoiding both unnecessarily high flue gas losses and too hot air temperature. This involves a combination of parallel and counterflow, which has been designated "combiflow." This is described in a thesis recently submitted to the Royal Institute of Technology, Stockholm, Sweden, by **István Juhász,** consulting engineer, for the degree of Teknisk Licentiat, and resulted from investigations conducted by him at the Institute under the direction of **Dr. T. Widell,** head of the Division of Heat Engineering.

A regenerative rotary air preheater built for combiflow would be divided into three sections such as is indicated schematically in Fig 2, the calculated temperature curves for this arrangement being shown in Fig. 1-c. It can be readily compared with the curves for counterflow and parallel flow in Figs. 1-a and 1-b, respectively.

From this set of curves it is apparent that the metal temperature at the cold end is between the values for counterflow and parallel flow. The temperature of the mixed counterflow and parallel-flow air is also between the values for counterflow and parallel flow. The same may be said of the flue-gas temperature at the cold end. It can also be seen that the flue-gas curve with combiflow, in the interval from $y = 0$ to $y = 0.5$, resembles the curve for parallel flow and that between $y = 0.5$ and $y = 1$ resembles more nearly the counterflow curve. The forms of the counterflow and parallel-flow air-temperature curves in the right-hand two sections of the heater (Fig. 1-c) are similar to those of the curves for pure counterflow and pure parallel flow (see Figs. 1-a and 1-b).

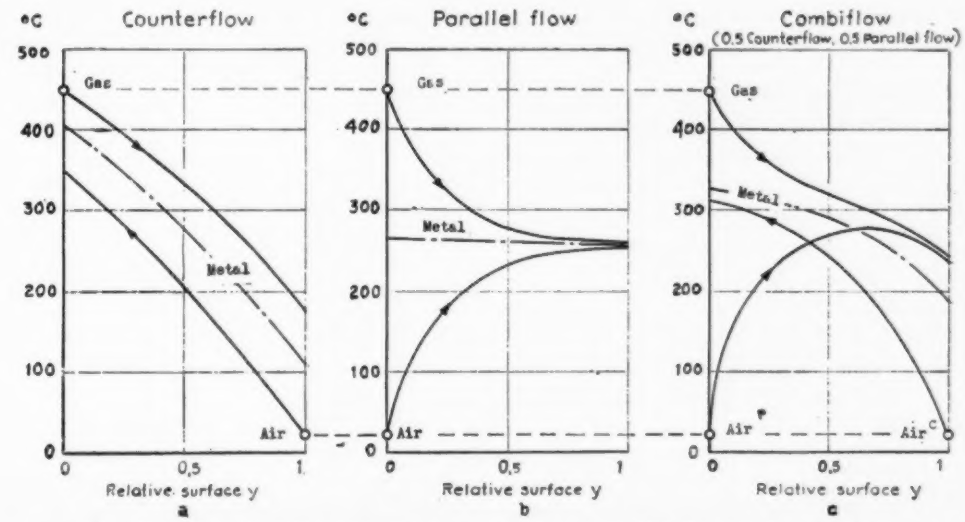
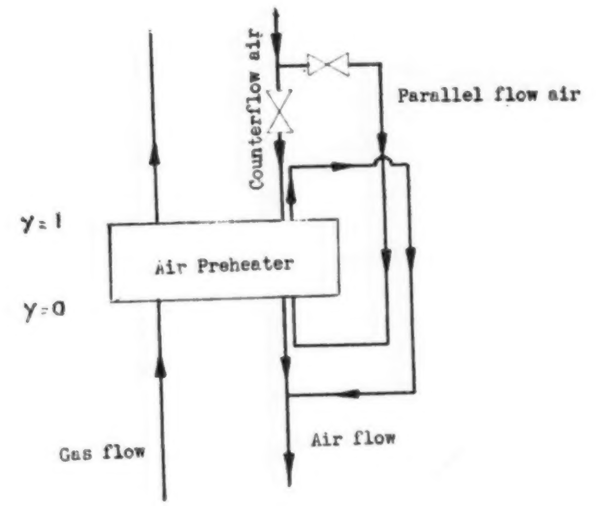


Fig. 1—Characteristic curves for counterflow, parallel flow and combiflow

From this set of curves it will be apparent that with equal flow in the two branches, the resulting values would be nearer those for parallel flow than those for counterflow. Hence a better result would be obtained by using a higher ratio of counterflow to parallel flow. However, the suggestion is made that it might be advisable to employ straight parallel flow when starting the boiler in order to avoid a low metal temperature at



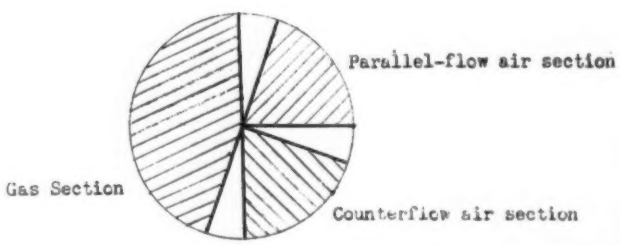


Fig. 2—Diagram of rotary regenerative air preheater of the Ljungstrom type arranged for combiflow. Patent pending.

the cold end, and then change to normal combiflow when the metal becomes warmer.

The thesis, which is written in Swedish, contains a mathematical analysis of the problem, and will be published later in English as *Transactions* of the Royal Institute of Technology.

Facts and Figures

Smoke is said to be responsible for only about a fifth of Chicago's smog.

•

More than 20 per cent of the bituminous coal consumed in the United States comes from surface mines.

•

Although the oil production in some states averages over a hundred barrels per well per day, the average output for the country as a whole is under 13 barrels.

•

About $3^3/_4$ bbl. of oil have been produced per ton of Kentucky coal at the Bureau of Mines' demonstration plant at Louisiana, Mo.

•

Use of overfire jets with spreader firing has been found to reduce carbon loss as well as dust emission.

•

More than 25 per cent of the revenue from sales taxes in West Virginia last year came from the sale of bituminous coal.

•

The Federal Power Commission reports that the nation's electric utility plants are now consuming bituminous coal at the unprecedented rate of 108 million tons a year.

•

It is advisable to use temporary gage glasses when boiling out a new boiler, as the deposits of oil and dirt that accumulate during the boiling out are likely to damage the regular glass.

•

According to the Defense Production Administration, approximately 94 per cent of the crude oil reserves are now in the free world; but if the Middle East were lost, the Soviets would control half the world's oil reserves.

•

The first semi-outdoor power station in Great Britain is being built by the British Electricity Authority, principally to supply power to the atomic energy plant at Capenhurst. Plans call for the installation of four 60,000-kw units.

•

Two new 145,000 kw turbine-generators are now being built for an extension to Kearney Station (Newark, N. J.) and are designed for 1100 F steam. They will be 3600-rpm, G. E. tandem-compound, triple-flow machines operating with 2350-psig steam supplied by two C.E. controlled circulation, reheat boilers.

•

The term "residual oils" is applied to the products that remain after the lighter fractions have been distilled from the crude. Included in this class is No. 6 oil which must be heated before it can be pumped and properly atomized.

Pertinent Court Decisions

By LEO T. PARKER

Attorney at Law, Cincinnati, Ohio

DISCUSSION has arisen from time to time over the legal question: If the owner of a steam plant signs a purchase contract containing a noncancellable clause, can he avoid paying the contract price, on the grounds that the product is unsatisfactory?

According to a recent court decision the answer is no, if previously the purchaser had paid for similar merchandise ordered from the seller.

For illustration, in *Dixie Pine Products Co. v. Universal Refining Products Co., 43 So. (2d) 752*, the former sued the latter for the contract price of a shipment of a chemical cleaning compound for steam boilers. The purchaser alleged that the compound was unsatisfactory and therefore he was not obligated to pay for it. Testimony showed that shipment of the material was made pursuant to a written order signed by the purchaser and also by the seller's salesman. This order gave an accurate description of the merchandise, the price and the terms of sale. It stipulated that all special agreements between the buyer and seller were incorporated in the order, and further that the order was not subject to countermand. The goods were shipped pursuant to the terms of this order.

The jury held that the purchaser must pay the full contract price. The higher court affirmed the verdict and said:

"Prior to the order here sued upon appellant (purchaser) had bought several orders of the same commodity aggregating about 5000 lb, and after using the product for several months placed the order now in question."

"It is contended by appellant (purchaser) that the order was cancelled or rescinded because the goods were not satisfactory and did not produce the desired results. This issue was submitted to the jury under conflicting testimony, and the jury found against appellant."

Plant Owner Sells Equipment

Recently the owner of a power plant asked this question: "We occasionally sell used and discarded equipment, materials, etc. In some instances the buyers make a small down payment and we subsequently do not hear from them. Some of these purchasers decide they do not want the equipment and forfeit the down payment while others delay unreasonably in taking delivery. How can we protect our interests and make disposition of the uncalled for equipment? Can we sell it to another buyer without being liable to the first purchaser? If not what can we do to avoid liability?"

First, it is well settled law that in order to avoid legal controversy from this source a written sale contract should be signed by both the purchaser and seller, and contain a clause stating definitely when the purchaser will pay the balance due and take possession of the merchandise.

If the purchaser pays cash in full for the merchandise or equipment he has an immediate and nonrevertable title, but the law expects him to remove the subject of the sale from the seller's premises within a reasonable time. If he fails in this respect the seller cannot resell the equipment, but may charge a reasonable sum for storage or rental.

According to a recent higher court, if the purchaser makes only a small down payment and the contract does not contain a clause which automatically forfeits to the seller the legal title to the purchaser, under such circumstances, the seller must wait a reasonable period of time after which he may resell.

For example, in *Anderson v. Universal Supply & Machinery Co., 218 Pac. (2d) 361*, testimony showed that the original owner of a discarded 100,000-gal steel water tank and water tower had sold this equipment to the Universal Supply and Machinery Co. for a few hundred dollars cash. Soon afterward the latter company resold the equipment to one Anderson for the sum of $1100, $200 of which was paid in cash at the time of purchase. The seller issued a receipt to Anderson, as follows:

"Received of Tom J. Anderson Two Hundred no-100 Dollars to apply on purchase price of one tank and tower. Balance $900.00."

It was agreed that Anderson would pay the remaining $900 due and owing on the equipment at some future date, not definitely specified.

Almost two years passed after which the Universal Supply & Machinery Co. sold the water tank and tower to another company for $1750. About two weeks later the new purchaser commenced dismantling the tank and tower and had expended about $2000 when Anderson filed suit claiming that he was the owner of the equipment and that he had the above mentioned receipt to substantiate his claim. Also, Anderson proved that immediately after having purchased the equipment he had four or five men inspect it and had expended considerable money making repairs. However, he admitted never having done anything toward taking possession and did not put any sign on the property to indicate that he was the owner. In other words, there was nothing to give the last purchaser, any notice that Anderson claimed ownership.

In subsequent litigation the higher court held that the sale by the original owner to Universal Supply & Machinery Co. was valid because the latter had paid cash for the equipment. Also, it held that the contract of sale made by the Universal Supply & Machinery Co. to the last purchaser was valid, saying:

"In the instant case plaintiff (Anderson) allowed the water tank and tower to remain where it was in the same condition for a period of more than two years without any mark of any kind thereon and with nothing whatever to give notice of his claim to ownership or possession.... In the absence of a contrary showing, proof of ownership carries a presumption of possession or control. Nothing contrary appears in the record.... Delivery could not have been made without possession or control."

Hence, this court held that since Anderson had not

paid the full contract price and had never taken possession or control of the equipment, the last purchaser, who had no knowledge of the prior sale to Anderson, had legal ownership of the equipment.

Circumstantial Evidence

In another case the court held that a jury may determine from circumstantial evidence what caused a steam boiler to explode.

In *Russell v. East Coast, 74 Atl. (2d) 335,* it was shown that a contractor took a contract to install certain heating boilers. Soon after the installation work was completed one of the boilers exploded. An inspection after the accident disclosed that in the pipe leading to the safety valve there was some kind of a compound resembling white lead, and also what appeared to be lampwick, such as is sometimes used for tightening joints.

Counsel alleged that employees of the contractor, when installing the boiler, had allowed the pipe compound and lampwick to get into the feed line, and that when the water became heated, the compound and lampwick, or the compound alone, was forced-through the boiler and into the pipe leading to the safety valve, and blocked it. This was confirmed by an expert witness who testified that, in his opinion, the compound which got into the water line was forced by the boiling water and steam bubbles into the connections of the safety valve and clogged them so that the valve wouldn't function.

Since the circumstantial evidence tended to verify these allegations, the jury held the contractor liable in damages for the explosion. The higher court agreed with the jury and said.

"From the plaintiff's proofs it appeared that the boiler which exploded had been tested by the manufacturer before delivery.... We think that the jury could have found from the evidence, and the legitimate inferences to be drawn therefrom, that sufficient compound was injected into the water system by the defendant's (contractor's) employees, while making the installation, to block the safety valves.... Further, that if the safety valve had functioned properly, it would have let the steam out and reduced the pressure in the boiler so that it wouldn't blow up."

Contract Automatically Renewed

Contrary to general opinion, it would appear that if an employee is hired on contract for a year, and after expiration of a year continues in the employment, the law infers that the employment continues upon the same terms and for another period of one year.

For example, in *Smith v. Shallcross Co., 69 Atl. (2d) 156,* testimony showed that one Smith was hired on contract at a salary of $8000 a year. He worked for the company for one year, at the end of which no further contract was made. Soon after the end of the first year Smith was discharged for reasons of economy. Smith then sued the company for $6442 the salary he would have earned the balance of the second year had he not been discharged. The jury rendered a verdict in favor of Smith and the higher court affirmed the verdict, saying:

"Where a contract of employment for a definite time is made and the employe's services are continued after the expiration of the time, the inference is that the parties have assented to another contract for a term of the same length with the same salary and conditions of service..... Since plaintiff (Smith) was hired for the definite period of one year and continued to render service after the expiration of that period, the jury could reasonably draw the inference that his contract had been renewed by implication for another year at the same salary and under the same conditions. Accordingly plaintiff is entitled to his verdict."

Not Double Taxation

According to a recent higher court the imposition of a "power" tax based on the power generated by engines, in addition to an occupational license tax is not "double taxation."

In *State v. Standard Corp. 43 So. (2d) 909,* it was shown that the state passed a "power" tax statute, in addition to an occupational license tax.

The court held the law valid even though it imposed a tax on the power used, and in addition to the occupational tax. It held that these two taxes are not double taxation.

Seller Breached Contract

Modern courts consistently hold that if a seller breaches any part of a sale contract the purchaser may rescind the contract and compel the seller to refund all moneys previously paid.

In *Walters v. Gotch, 221 Pac. (2d) 733,* testimony showed that one Walters for several years had been engaged in a manufacturing business which he gave up during World War II, but subsequently undertook to find a suitable site for re-establishing his business. Consequently he entered into a written contract with one Gotch to buy a thirteen-acre tract of land at a price of $7800. Five thousand dollars in cash was paid down and the balance, namely $2800, was to be paid in monthly installments of no less than $50 each. Gotch had kept on the premises a large amount of scrap iron and sheet metal and two relatively large boilers. There was also a 30- × 70-ft building used as a dry kiln. Walters was anxious to construct a building on the premises in order to carry on his manufacturing operations and the following provision was included in the sale contract: "It is understood and agreed that the seller is to clear off all debris—consisting of the scrap, boiler, and buildings, but that the concrete foundations will not be removed—within ninety days from date of this contract."

Gotch removed several truckloads of the sheet metal, but was still engaged in removal of debris at the expiration of the ninety day period specified in the contract.

Walters then sued and asked the court to rescind the contract and compel Gotch to refund the $5000 down payment, because the latter had breached his agreement to remove all debris from the premises within 90 days from the date the contract was signed. The higher court held in favor of Walters, saying:

"The failure to move the dry kiln particularly deprived the plaintiff (Walters) purchaser of his right to use the property.... A clause in land contract is binding on both parties to contract."

Voluntary Risk

A recent higher court held that an employee who assumes a risk voluntarily, and outside the scope of his employment, cannot receive compensation for an injury.

In *Peoples Gas, Light & Coke Co. v. Industrial Commis-*

sion, 89 N. E. (2d) 808, the testimony showed that one George had been employed by the company for more than 22 years as a fireman. One day he was directed by his foreman to pull ashes and assist the engineer in washing air ducts in the subbasement. Upon finishing this job he did not report back to his foreman, but upon his own volition and without knowledge of the foreman, he climbed to the top of a cupola, which was the junction point of different conveyor belts and, as he testified later, *to clean up and carry away some dust that he found in the tower.* Here he loafed and gazed out of the window. At this time the belts were empty and not in operation. Finally, George started the belts and his hand was caught under a roller while he attempted to remove dirt from the belt. His calls for help were heard by the foreman. The belts were stopped and his hand released. He sued for compensation under the state's Workmen's Compensation Act.

During the trial George admitted that no one told him to clean the belts. Therefore, the court refused to award him compensation, saying:

"This was strictly outside his scope of authority, express or implied, and in doing so he was a mere volunteer. In short, he was doing something he was not required to do and had no business doing."

Independent Contractor Solely Liable

Considerable discussion has arisen from time to time over the question: How can a corporation avoid liability for injuries to employees and private property caused by defective equipment? If a corporation employs an "independent contractor" to do a job it is not liable if, through negligence of the contractor, an injury to an employee or private property results. In other words, the independent contractor is solely liable, thereby relieving the corporation from liability.

For illustration, in *Allison v. Ideal Laundry, 55 S. E. (2d) 281*, it was shown that the laundry company converted its coal fired boilers to gas firing. This work of conversion was handled by a contractor who was paid a flat contract price for the job. One day thereafter an employee of the laundry asserted that gas was escaping because he heard a hissing sound. A few moments later the escaped gas was ignited through some unknown means and considerable damage was done to near-by property.

Since the escaping gas appeared to have been caused by negligence of the contractor who performed the work of converting the laundry from coal to gas, the court was asked to rule on who was liable for resultant damage. The opinion refused to hold the laundry company liable, and said:

"In view of the considerations which have been stated, the laundry company cannot be justly subjected to liability for the independent contractor's negligence."

Manufacturer Liable on Guarantee

Discussion has arisen from time to time over the question: When is the manufacturer of equipment liable on a guarantee to a purchaser, and how can a dealer avoid such liability? The answer is: A retail dealer may avoid such liability by having the manufacturer guarantee the equipment to the purchaser. According to a recent court ruling a retail dealer is liable only when the testimony shows that he personally made the guarantee.

For illustration, in *Potter v. National Supply Co. 51 S. E. (2d) 908*, the testimony showed that a purchaser named Potter sued for breach of warranty of a marine engine. The testimony showed that the manufacturer had sent its salesman or agent to interview Potter. This agent guaranteed the engine, although the sale was made through a dealer. In fact, the testimony showed that the buyer asked the manufacturer's salesman if such an engine would turn a 50-in. propeller of 34-in. pitch at 600 rpm. The salesman replied that he "would guarantee it to turn 600." Relying on "the guaranty," the buyer agreed to buy the engine which was to cost $12,000. A few days thereafter the dealer issued a purchase order to the manufacturer for the engine and later delivered it to Potter, but it failed to meet the guaranteed performance.

In subsequent litigation the higher court held that the manufacturer had breached its contract to Potter, and held the manufacturer solely liable in damages.

Attractive Nuisance

It is generally established that the owner of a plant is liable in damages for injury or death of a child caused by an "attractive nuisance," and owners of "attractive nuisances" are required by law to safeguard children. However, according to a recent court decision an ordinary water reservoir is not a legal "attractive nuisance."

A case in point is *Newsby v. West Palm Beach, 47 So. (2d) 527*, where the testimony showed that a corporation owned a spray pond situated within the corporate limits of the city. It was not fenced and was surrounded by grasslands or lawns.

One day an eight-year old child was attracted by the reservoir and while playing near it, fell into the water and was drowned. The parents sued the corporation to recover damages, contending that it was liable because the spray attracted children and the owner should have erected fences or placed guards to prevent children from falling into the reservoir.

In holding the corporation not liable, the higher court said:

"Legal remedies should not be confused with Good Samaritan impulses. The courts may enforce the former but they have no power to relieve against delicts of the latter. We are therefore driven to the conclusion that the water spray was not the proximate cause of the child falling into the water, and it is not shown that the reservoir was constructed so as to constitute an unusual element of danger."

For comparison, see *Allen v. P. McDonald Corp. 42 So. (2d) 706*. In that case there was an artificial pond, constructed in a thickly populated area. Adjacent to the pond were banks of white sand that attracted children of tender years, one of whom, a child two and one-half years of age, slid down the bank into the water and was drowned.

In this case the higher court held the corporation liable for death of the child on the basis that the white sand was an "attractive nuisance" and a fence should have been constructed to prevent children falling into the pond.

This court held that the owners of artificial lakes, fish ponds, mill ponds, and other pools, streams and bodies of water are guilty of negligence on account of drownings of children if there is some unusual element of danger lurking about them not existent in ponds generally, and especially attractive to children.

DOWELL SERVICE

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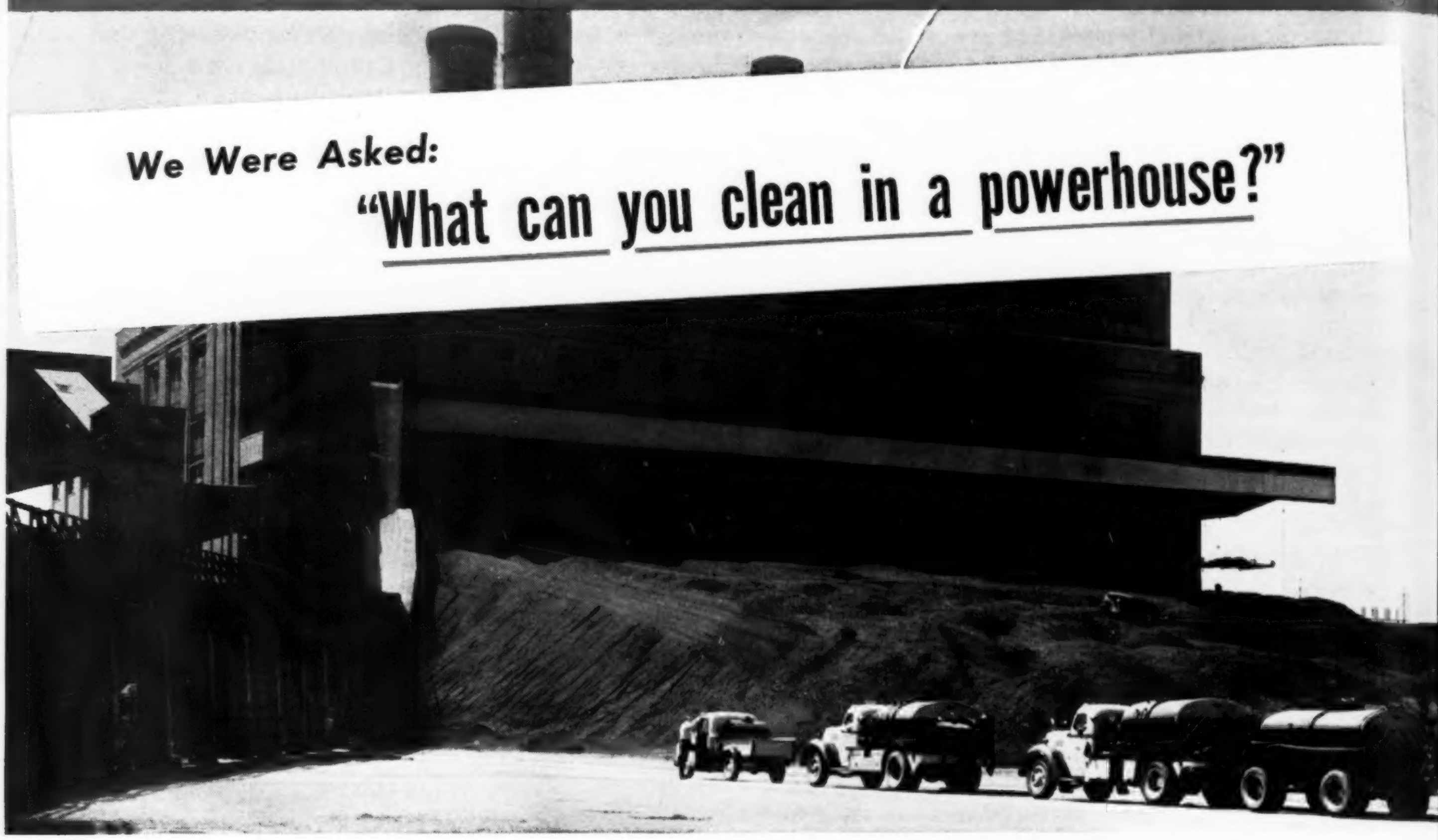
"What can you clean in a powerhouse?"



Here's Our Answer... *Proved by recent Dowell Jobs!*

There are many places in every industrial plant where Dowell Service can cut operating costs and *increase production time*. Wherever deposits on the surfaces of condensers, boilers, heat exchangers, water lines and other equipment are reducing capacity, Dowell Service can show money-saving results.

Dowell furnishes trained personnel and all necessary special equipment. Dowell engineers apply liquid solvents according to the technique demanded by the job: for example, by filling, spraying, jetting, cascading or vaporizing. The solvents are designed to remove deposits *quickly*, efficiently and economically. Dismantling is unnecessary and downtime is kept to a minimum. Often equipment can be cleaned while it is in operation.

Experienced Dowell engineers will be glad to consult with you on your particular problems. Call the nearest Dowell office today!

BOILER: A boiler was making only 12,000 lbs. of steam per ton of coal. After Dowell Service, the output increased to 18,000 lbs. of steam per ton of coal.

ECONOMIZER: A return-bend, integral economizer was cleaned by Dowell Service in 8 hours with no dismantling.

SUPER HEATER: Several tubes had blown out on a pendant type, non-drainable superheater because of heavy deposits. In just two working days Dowell Service did a complete job of removing these troublesome deposits.

TURBO SURFACE CONDENSER: An 800 KW Turbo Condenser was cleaned by Dowell. Result: The drop in steam rate demand represented an estimated yearly savings of $3600 in coal.

EVAPORATOR: Before cleaning, an evaporato operated at 24 lbs. per square inch steam an 11 inches of vacuum. After Dowell Servic it operated at 4 psi. steam and 13" vacuum

HEAT EXCHANGER: Pressure drop on a hea exchanger was 52 lbs. with 150 gallons pe minute flow. After Dowell Service, pressur drop was 22 lbs. with 200 g.p.m. flow.

BOILER FEED LINES: Before cleaning, it wa necessary to use three 100 horsepowe pumps to force water through clogged feed lines to the boiler house. Following Dowel Service, only one pump was required.

PUMP: Two high pressure feedwater pump were nearly clogged with deposits. Dowel Service cleaned them along with the rest o the feedwater system.

TURBINE: Deposits on the rotor and stator o a turbine were removed quickly and effi ciently by Dowell Service *in three hours.*

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Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

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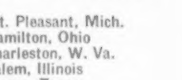

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New Process Obtains Tar and Low-Cost Power from Lignite

AFTER nearly two years of research, the U. S. Bureau of Mines has announced a new process that offers promise of making the West's immense reserves of lignite and other low-rank non-coking coals a major source of both low-cost power and coal tar products.

Soon to be applied commercially in providing fuel for power generation at a new aluminum smelting plant in Texas, the process was developed in the Bureau's coal branch laboratories and pilot plants at the Denver Federal Center under a cooperative agreement with the Texas Power & Light Co.

Major products of the process, a variation of low-temperature carbonization, are a high heating value char suitable for power plant use and crude coal tar, which is the source of a myriad of by-products, including wood preservatives, plastics, explosives, drugs and dyes. According to V. F. Parry, chief of the Denver laboratories and the man under whose supervision the process was developed, the process is applicable to any coal of lesser rank than high volatile bituminous B, a bracket that encompasses 90 per cent of all western coals. He stated further that if merely an average western coal is used, the value of the tar recovered—at least 8 to 10 cents per gallon—alone is equal to the cost of the raw coal, whereas the more favorable coals will yield as much as 45 to 55 gallons of tar oil per ton. Indicated processing costs are relatively nominal, and the char remaining can compete with natural gas as a fuel.

Competitive with Gas

According to the calculations based on pilot plant results, profits from the 14 gallons of tar recovered from a ton of Milam County, Texas, lignite should enable even this fuel to compete with natural gas selling at 5 to 8 cents a thousand cubic feet.

Some 10 years ago, large volumes of natural gas were available in Texas under long-term contracts for as little as $3^1/_2$ cents a thousand cubic feet. Now, with many new pipe lines being completed and with Gulf Coast industry expanding rapidly, there is intense competition for the limited reserves still available. Hence natural gas prices have tripled, and only short-term contracts are being negotiated.

Milam County, Texas, has been selected by the Aluminum Company of America as the site of a new aluminum smelting plant that will have a capacity of 85,000 tons of metal annually with initial production scheduled for the fall of 1952. When in full operation, the plant will employ about 1000 persons.

The large amounts of electricity required by the new plant will be generated by steam-driven equipment using as fuel lignite processed by the Bureau's carbonization method. Power generating facilities will be built and operated for ALCOA by the Texas Power and Light Co.

The Bureau of Mines has designed for the Texas Power & Light Co. a 575-ton-a-day lignite processing unit, which is patterned after its own two pilot plant units. A battery of twelve 575-ton-a-day units, costing approximately $9,000,000, will be needed to supply fuel for generating the power required by the new ALCOA aluminum smelter. Using nearly 7000 tons of lignite daily, they would produce some 3200 tons of char and 2300 barrels of tar.

Large Reserves

Reserves of lignite in Milam County are known to total more than 100,000,000 tons, and exploration work now in progress is expected to add to this figure. It can be extracted both by strip and slope mining at an estimated cost of only $1.00 to $1.50 a ton, which aids materially in enabling lignite to compete with natural gas for power production.

Raw lignite, containing some 35 per cent moisture, has a heating value of 7000 Btu per lb, but the bone-dry char, obtained after processing this lignite, has a heating value of 10,600 Btu per lb. Although having only 45 per cent of the weight of the raw lignite, the char retains 75 per cent of the heating value. This obviously advantageous shipping factor ultimately may mean that char processed from mountain-state coal could be shipped to the west coast to fuel power plants and industry there at such time as fuel oil becomes short.

Process Described

In the Bureau's process, lignite or other low-rank non-coking solid fuel is crushed to $^1/_4$-in. particles or smaller. To remove the moisture, the crushed fuel is "boiled" at 350 F in a fluidized dryer that uses the hot products of combustion or flue gas as the heating medium. Then, the hot, dry fuel is moved pneumatically to a carbonizing reactor, where it is burned with air at a temperature of 950 F to extract the tar oils and obtain a char. This transformation, it is claimed, can be made at an overall thermal efficiency of about 91 per cent.

ASME Fall Meeting Program

MINNEAPOLIS, Minn., will play host to the 1951 ASME Fall Meeting which is to be held at the Hotel Radisson on Sept. 26–28. A program of twenty-three sessions during which forty-nine technical papers will be delivered has been announced, covering such fields as management, power, industrial instruments and regulators, heat transfer, fuels, education, materials handling, metals engineering and gas turbine power.

In addition to the technical papers and general interest addresses, the program will include inspection trips to Brown & Bigelow, St. Paul; General Mills, Inc.; Minneapolis-Honeywell Regulator Co.; Minneapolis-Moline Co. and the Hydraulics Laboratory of the University of Minnesota.

Portions of the program which are of general and specific interest to engineers in the steam power field include the following:

Wednesday, Sept. 26, 9:30 a.m.

"Recent Developments in Industrial Turbines" by Arthur D. Somes, General Electric Co.

"Effect of Exhaust Pressure on the Economy of Condensing Turbines" by Jack E. Downs and Allen Keller, General Electric Co.

Wednesday, Sept. 26, 12:15 p.m.

President's Luncheon

"Welcome to Northwest Where Agriculture and Industry Meet" by W. C. MacFarlane, Minneapolis-Moline Power Implement Co.

Wednesday, Sept. 26, 2:30 p.m.

"Steam Generating Unit Design for Burning Coals from the Northern Great Plains Province" by Otto de Lorenzi and John H. Cruise, Combustion Engineering-Superheater, Inc.

Wednesday, Sept. 26, 5:00 p.m.

Calvin W. Rice Lecture

"Engineering Achievements in Switzerland and Their Background" by Dr. Frederick Oederlin, Sulzer Brothers, Ltd.

Wednesday, Sept. 26, 8:00 p.m.

Junior Conference on the subject "A Current Plan for Young Engineers" led by Fred T. Agthe, Allis-Chalmers Mfg. Co.

Thursday, Sept. 27, 9:30 a.m.

"Operation of Large Power Boilers with Lignite Coals from the Dominion of Canada and Northern United States" by John M. Drabelle, Iowa Electric Light & Power Co., and John W. Hoffman, Northern States Power Co.

"Basic Elements of Design and Operation of Steam Generating Units for Utilization of North Dakota Lignites in Central Station Practice" by Leo Pistner, Fuel Economy Engineering Co.

"Current Research on Lignite" by Alex C. Burr, U. S. Bureau of Mines.

Thursday, Sept. 27, 12:15 p.m.

Roy V. Wright Luncheon and Lecture by John W. Barriger, Chicago, Indianapolis and Louisville Railway.

Thursday, Sept. 27, 2:30 p.m.

"Coal Handling Conveyors at Power House and Dock" by Frank W. Lovett, Link-Belt Co.

"Storage of Coal" by W. L. Lundy, Kimberly-Clark Corp.

"Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater" by V. J. Calise and R. K. Stenard, Graver Water Conditioning Co.

"Industrial Plant Boiler Feedwater Treatment" by D. C. Carmichael, E. I. du Pont de Nemours and Co.

Thursday, Sept. 27, 7:00 p.m., Banquet

J. Calvin Brown, president of ASME, speaker.

Friday, Sept. 28, 9:30 a.m.

"A Contribution to the Problem of Designing Radial Turbomachines" by O. E. Balje, Fairchild Corp.

"Theory of the Radial Inflow Turbine" by Prof. P. F. Martinuzzi, Cornell University.

Friday, Sept. 28, 2:30 p.m.

"Some Theoretical Aerodynamic Investigations of Impellers in Radial and Mixed-Flow Centrifugal Compressors" by John D. Stanitz, National Advisory Committee for Aeronautics.

"Single-Stage Radial Turbines for Gaseous Substances with High Rotative and Low Specific Speed" by W. T. Von der Nuell, Airesearch Corp.

"Coal and Ore Transfer from Rail Car to Lake Vessel" by E. E. Bauer, Heyl and Patterson.

Railroad Motion Picture

A new 16-mm, full-color sound motion picture entitled "Shining Rails" has been produced for the General Electrical Co. under the technical supervision of the Company's Transportation Division. It tells the story of major developments in railroad progress over the past 25 years, covering such phases as communications, materials handling, signaling, and the diesel and gas-turbine electric locomotives. There are some impressive scenes of railroad electrification and of coal and ore handling at lake ports. Animation is effectively used to show the basic principles underlying various types of railroad motive power. The 20-minute picture will be available for loan from G. E.

Cleaner Air Week

"Cleaner Air Week" will be observed in the United States and Canada from Oct. 21 to 27. This announcement was made by Charles N. Howison, of the Air Pollution and Smoke Prevention Association of America.

The observance was originally inaugurated to focus attention upon the need for control of air pollution from all sources, including smoke, soot, fly ash, noxious fumes and gases, and to serve as a starting point for year-round smoke abatement and air pollution control activity by public officials, schools, industry, railroads, apartment houses, homes and civic institutions.

The week was formerly known as National Smoke Abatement Week, but its name was changed in order to cover the wider scope of activity of the Association.

Governors of most states, and mayors of hundreds of cities, will proclaim the week officially in their jurisdictions, as they did last year. City air pollution control officials will cooperate with their local newspapers and radio and television stations by outlining their activities during the year, so that the communities will know what is being done to minimize air pollution. Also, chambers of commerce and civic organizations are being alerted to support the project in their communities by placing posters in store windows, plants, schools, libraries, and on billboards. In addition, a number of radio addresses are being prepared on which local programs can be patterned. Smoke abatement techniques will also be developed for television shows.

The principal supporters of "Cleaner Air Week" include the National Coal Association, Appalachian Coals, Inc., Pocahontas Operators Association, The Smoke Abatement League of Hamilton County, Ohio, and the Air Pollution and Smoke Prevention Association of America.

John Fritz Medal Award

Ervin G. Bailey, past president of The American Society of Mechanical Engineers and vice president of Babcock & Wilcox Co., has been selected by the John Fritz Medal Board of Award to receive the 1952 John Fritz Medal and Certificate "for outstanding engineering achievements in the field of combustion and distinguished service to his fellows in advancing the engineering profession."

The John Fritz Medal, established in 1902 by friends of John Fritz on the occasion of his eightieth birthday to honor him for his great contributions in the manufacture of steel and in the advancement of industry generally, is perpetuated by the four leading engineering societies, the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers and American Institute of Electrical Engineers, as a joint honor for scientific or industrial achievement in any field of pure or applied science.

Mr. Bailey is a member of several national professional societies and of several honorary engineering societies. He is one of the few American engineers who are honorary members of The Institution of Mechanical Engineers, Great Britain.

Program of Joint Fuels Conference at Roanoke

The 14th Joint Fuels Conference sponsored by the Coal Division of the American Institute of Mining and Metallurgical Engineers and the Fuels Division of the American Society of Mechanical Engineers will be held at the Roanoke Hotel, Roanoke, Va., on October 11 and 12.

Included on the program are three panel discussions and one general session on the technology of coal preparation and use as a fuel. A high point of the meeting will be the banquet on Thursday evening at which the Percy Nicholls Award for 1951 will be presented to Albert R. Mumford, research engineer of Combustion Engineering-Superheater, Inc.

The technical program for Thursday, October 11, is primarily concerned with problems of coal mining and distribution. The first panel discussion, scheduled for 9:30 a.m., will be devoted to a study of thickening and desliming equipment and practice as related to coal preparation. At the luncheon the speaker will be R. H. Smith, president of the Norfolk & Western Railway Co. The afternoon session at 2:00 p.m. will feature a panel discussion on "Engineering Service in the Coal Industry." Principal speaker at the banquet at 7:15 p.m. will be Dr. Walter S. Newman, president of Virginia Polytechnic Institute, while A. W. Thorson will present the Nicholls Award to Mr. Mumford.

The following papers will be presented at a technical session on Friday morning:

"Determination of the Free Swelling Index of Coal Employing Electric Furnaces and Heaters" by E. Swartzman and G. C. Behnke of the Canadian Bureau of Mines.

"Air Pollution from Gob Piles" by Henry F. Hebley of Pittsburgh-Consolidation Coal Co.

"Changing Characteristics of Storage Coal" by T. F. Downing, Jr., of Philadelphia Electric Co.

"Filter-Cake Size-Consist and Moisture Relationships" by O. R. Lyons of Republic Steel Corp.

Featured in the Friday afternoon technical session will be a panel discussion entitled "Fuel and Equipment Consulting Service for Small Steam Generating Plants." A. R. Miller of General Foods Corp. will present the viewpoint of the small plant owner and Earl C. Payne of Pittsburgh-Consolidation Coal Co. that of the coal producer. The respective points of view of the consulting engineer and the equipment manufacturer will be expressed by H. C. Carroll of Commercial Engineering and Testing Co. and E. C. Webb of Iron Fireman Corp. W. S. Major of the Dravo Corp. will speak from the viewpoint of the construction contractor.

Charles T. Holland is general chairman of the meeting, assisted by Fred K. Prosser as co-chairman. For the AIME Coal Division C. A. Garner serves as chairman, while Carl E. Miller holds a similar position in the ASME Fuels Division. The program for the ladies includes a tour to Natural Bridge Virginia, and a visit to Lexington, Virginia.

New Utah Power Station Burns Pitch

The first section of the new semi-outdoor Gadsby Steam Station of the Utah Power & Light Company at Salt Lake City, which has just gone into service, is burning pitch pumped from a refinery $4^1/_2$ miles distant. This was described in a paper by E. M. Naughton of that company before the Pacific Coast Meeting of the AIEE at Portland on August 23.

Although the boiler of this 60,000/66,000-kw, 1250-psi, 950-F unit is capable of burning coal, oil or pitch, it was found economical for the initial installation to take advantage of the availability of the pitch. Therefore, installation of pulverizers and coal-handling equipment was deferred. However, the second section of the plant, scheduled for operation late in 1952, will burn coal. Furthermore, it will have 75,000 kw capability, will operate at 1450 psi and will employ reheat to the initial steam temperature of 1000 F. The calculated station heat rate, because of the higher steam conditions and reheat, is 10,450 Btu per kwhr compared with 11,200 Btu for the first section. The plant is designed for the ultimate installation of three turbine-generator units, each served by its own boiler.

The pitch that is being burned at Gadsby is the residue from the manufacture of gasoline and diesel fuel. It has a high pour point and must be heated to 225 F for pipe line transport, with further heating to 350 F at the station to permit steam atomization. Storage in insulated tanks is provided both at the refinery and at the power plant.

Delivery of the pitch is through a line consisting of a 14-in. hermetically sealed shell with expansion loops every 700 ft. There is 2 in. of insulation inside the shell, and inside that is a 5-in. transport pipe and a 4-in. steam line. One half of the line is heated by steam from the refinery and the other by steam from the plant. Conventional combination pulverized coal and steam-atomizing oil burners, firing through the front wall, are employed.

Research Delving into Corrosion at High Temperatures

Much information on the corrosive effects of various hot environments has been accumulated by the Development and Research Division of The International Nickel Co., Inc., according to T. H. Wickenden, vice president in charge of the division. This has involved a continuing and expanding program designed to evaluate the corrosion resistance at high temperature of different metals and alloys for specific applications, especially those pertaining to the defense program.

"There is still a great deal to be learned about high-temperature corrosion, not only with respect to some of the underlying principles governing surface reactions, but also from the practical aspect as to means of eliminating or minimizing corrosion damage by selection of appropriate alloys," Mr. Wickenden said. "As operating temperatures in many industries continue

to increase, it is inevitable that high-temperature corrosion problems should multiply on a cumulative basis.

"Studies are being accelerated tremendously by the defense program, which involves not only military and naval equipment and supplies, but processes by which matériel of all kinds is produced."

Mr. Wickenden pointed out that a large amount of data on the creep and rupture characteristics of materials at temperatures up to and including 1800 F and some data at temperatures as high as 2100 F, have been secured in the Company's Laboratories at Bayonne, N. J., and Huntington, West Va. In addition, test spools, or racks, have been installed under actual operating conditions in industry. Each of these spools contains specimens of a variety of alloys and a comparison of their performance is made at frequent periods of time.

While strength characteristics are unquestionably important, Mr. Wickenden emphasized that to achieve long life and trouble-free service in high-temperature environments, it is usually necessary to place governing importance on the corrosion behavior. This fact has been further confirmed by information on high-temperature corrosion mechanisms studied at the Bayonne and Huntington Laboratories and by engineers of the division.

Output and Capacity Increase

A steady increase in the output of electric utility plants in the United States, accompanied by a marked increase in the consumption of both coal and natural gas and a decrease in the oil burned is revealed in figures just released by the Federal Power Commission.

These show that during the first six months of the present year the output totaled 179,561,188,000 kwhr of which 71 per cent was generated by fuel and 29 per cent by water power. The gain over the like period of 1950 was 19 per cent in thermal-plant generation and 4.6 per cent by hydro.

For the twelve months ending June 30, 1951, the output was nearly 352 billion kilowatt-hours, which not only was the highest on record for such a period, but also represented an increase of 15.6 per cent over that for the twelve months ending June 30, 1950.

Reports received by the Commission during July indicated the installed capacity, as of June 30, to be in excess of 72 million kilowatts which included a net increase of some 950,000 kw during the month. It represented a gain of 6,700,000 kw over the capacity reported for June 30, 1950.

Coal consumption during June of the present year exceeded 8 million tons; that of oil approximately $4^1/_2$ million barrels; and gas $75^1/_2$ billion cubic feet. Compared with a year previous, the coal use had increased 14 per cent, that of gas 23.7 per cent; and for oil there was a decrease of 13.9 per cent.

The indicated average coal rate, based on reported June figures, was 1.14 lb per kwhr.

REVIEW OF NEW BOOKS

Any of the books here reviewed may be secured through Combustion Publishing Company, Inc., 200 Madison Ave., N. Y.

The Thermal Testing of Steam Boilers

By Leslie S. Brown

In Great Britain the Lancashire and Economic types of fire-tube boilers continue to have widespread use in industrial plants. This well-written book is intended for operators who desire to obtain an estimate of boiler performance of small steam plants. Detailed steps are given for calculating thermal gains and losses, and there are instructions on procedures for conducting tests, mainly on small fire-tube boilers.

Allowing for differences in British and American practice, it is to be regretted that specific heat tables more recent than 1924 were not included in the book. Also, more references might have been made in the text and in the appended bibliography to applicable test codes.

This is one of the few books on boiler testing that has been written in simple language suitable for boiler plant operators. There is a need for a comparable work based on American practice.

The 149-page book sells for $4.

Flyveaskeudskillere (Fly-Ash Separators)

By Knud Hansen

Written in Danish this book is concerned with the theory of fly-ash separation and equipment designs that have been tried out in operation. Many types of European and American separators are illustrated by diagrams and photographs. Considerable emphasis is placed upon laboratory tests of the physical properties of fly ash.

Some of the chapter headings are translated as follows: Characteristic Data of Fly Ash, Grain Size Determination, Measuring Efficiencies of Separation, Efficiencies of Fly-Ash Separators, Installations of Fly-Ash Separators.

There is a bibliography of more than 100 references, mainly from European sources. Information on this 201-page paper-bound publication of the Danish Academy of Technical Sciences may be obtained from G. E. C. Gad, Vimmelskaftet 32, Copenhagen, Denmark.

Introduction to Heat Transfer Second Edition

By A. I. Brown and S. M. Marco

In the second edition of this text the authors have retained their original objective of providing a book suitable for teaching fundamentals of heat transfer to undergraduate engineering students. The revision has been made desirable partly by the appearance of new data on thermal conductivity and viscosity of air and other gases whose properties are involved in many problems of heat transfer by convection.

New materials have been added to the chapters on conduction and radiation, particularly relating to the characteristics of insulating materials and to calculation of solar radiation. Because of the increasing interest in the relationship between fluid flow and heat transfer the material on fluid flow has been expanded. Several changes in nomenclature have been made in order to conform more closely to current standards, and a table of conversion factors has been added. In addition to other revisions to bring data up to date, the number of problems, all without answers, has been doubled.

The text contains 267 pages and sells for $4.50.

Mineral Wool Insulation Handbook

A practical insulation handbook, "Mineral Wool Insulation Specifications & Standards," has just been published by the Industrial Mineral Wool Institute for buyers, engineers, plant superintendents, specifications writers and contractors as a guide in properly selecting materials and application practices for government contracts and as a basis for specification within industry itself. Bound in a tough flexible cover for long use on design tables and in the field, the handbook includes twenty-one specifications and standards by four government agencies and the American Society for Testing Materials.

Among the subjects helpful in specifying and installing mineral wool insulations for most satisfactory and reliable performance are: types of products, physical properties, characteristics, construction, selection, standard dimensions, temperature limits, thicknesses, auxiliary materials, application techniques and testing methods. Specifications by each of the five sources are placed together in sections identified by celluloid tabs. The handbook, with removable binding posts, may be kept complete and up-to-date by the insertion of additional pamphlets, data, notes and newly issued specifications.

Of the 15 specifications and standards by governmental agencies, seven are Federal specifications approved by the Director of Procurement for the use of all departments and establishments of the Government. Three Specifications are by the Navy Department and two by the U. S. Maritime Commission. Also included are Commercial Standards CS117-49, CS105-48 and CS131-46 issued by the National Bureau of Standards (U. S. Department of Commerce).

Of the six A.S.T.M. Specifications, three tentative and two proposed previously have not been available to industry. The A.S.T.M. specifications cover six types of industrial mineral wool insulation—mineral wool cement, batt, blanket, felt, and blanket-type and molded-type pipe insulation.

The handbook is priced at $3.20.

Annual Water Conference Program

The Twelfth Annual Water Conference sponsored by the Engineers' Society of Western Pennsylvania will be held at the Hotel William Penn, Pittsburgh, October 22 through 24. Papers and discussions scheduled for the program are as follows:

Monday morning, October 22

"An Inspection Report after 18 Months with Hot Lime Zeolite" by W. S. Butler, Dow Chemical Co.

Monday afternoon, October 22

"Factors in Evaporator Purity Testing" by J. T. O'Rourke, American Locomotive Co.

"Compression Distillation" by O. M. Elliott, consulting engineer.

Tuesday morning, October 23

"Feedwater Treatment Requirements for Packaged Steam Generators" by J. F. Wilkes and E. M. Welch, Dearborn Chemical Co.

"Steam Testing for Operating Control Can Be Simple" by F. U. Neat, Consolidated Gas Electric Light and Power Co.

Tuesday afternoon, October 23

Panel discussion on chemical cleaning of boilers including talks on alkali boilout of boilers, acid cleaning of new boilers, advantages of chemical cleaning of serviced boilers, procedures for chemical cleaning of boilers, corrosion and after-deposits resulting from chemical-cleaning process, phosphoric vs. hydrochloric acid in boiler cleaning, and removal of copper from boilers.

Wednesday morning, October 24

"Metallic Phosphates and the Langelier Index" by H. A. Malley and W. J. Stone, Deady Chemical Co.

"The Application of Soluble Silicates As Corrosion Inhibitors" by William Stericker, Philadelphia Quartz Co.

Wednesday afternoon, October 24

"Concentrating Films: Their Role in Boiler Scale and Corrosion Problems" by H. M. Rivers, Hall Laboratories, Inc.

"Control of Iron Oxide Deposits in High-Pressure Boilers" by R. C. Ulmer and J. H. Whitney, E. F. Drew Co.

"The Use of Galvanic Magnesium Anodes for Corrosion Prevention" by H. A. Humble and R. L. Featherly, Dow Chemical Co.

NEW CATALOGS AND BULLETINS

Any of these may be secured by writing Combustion Publishing Company, 200 Madison Avenue, New York 18, N. Y.

Oxygen Recorder

Hays Corporation has prepared a 16-page illustrated bulletin, No. 51-829, on the Magna-Therm Oxygen Recorder. The bulletin includes an introduction telling of typical applications, an explanation of the analyzing section utilizing the paramagnetic properties of oxygen, a diagrammatic explanation of the operation of the recorder section, and chart-illustrated discussions of the results obtained with the oxygen recorder.

Return-Line Corrosion

A four-page folder, Bulletin No. 5013, prepared by the Dearborn Chemical Co., discusses two amine-type treatments for controlling return-line corrosion. The bulletin also includes test procedures for both treatments.

Electrical Metallic Tubing

A brochure prepared by the Steel and Tubes Division of Republic Steel Corp. provides a description of Dekoron-Coated Electrunite electrical metallic tubing. A corrosion-resistant polyethylene coating is applied to this tubing, making it suitable for enclosing wiring circuits in corrosive atmospheres. The brochure gives engineering data on the properties of the coated tubing.

Chain Drives

A useful 32-page bulletin entitled "Installation, Operation and Maintenance of Chain Drives and Conveyors" has been published by the Chain Belt Co. Intended to show the user how to get the most service from sprocket chains, the bulletin has a text which is short but complete. Its illustrations show graphically the correct and incorrect ways of solving chain installation, operation and maintenance problems. A section on adjustment and repairs has an interesting check chart of cures for "sick" chains.

Steam and Air Traps

Armstrong Machine Works has issued a 12-page condensed catalog giving data and prices on steam traps and air traps. The catalog lists cast semi-steel and forged-steel bucket traps, compound steam traps, ball-float air traps, Y-type strainers and internal check valves. There are four pages of data on calculation of condensate loads and selection of traps to handle these loads, including a full-page steam-trap capacity chart.

Vertical Pumps

Ingersoll-Rand Co. has prepared an eight-page catalog describing the Class APH-APK line of vertical turbine-type pumps. The catalog includes cutaway views, installation scenes, and approximate dimensions of these pumps which are applicable to bulk liquid transfer, cooling tower, dewatering and similar services where suction is taken from an open source.

Steam Traps

An informative 24-page bulletin on steam traps, T-1740, has been prepared by the Yarnall-Waring Co. Besides giving some of the history and advantages of Yarway traps the bulletin tells how to figure sizes and offers installation and operating suggestions. One section has a chart showing the sizing of return pipelines. A 20-page supplement, T-1750, has been issued to aid in selection of traps. It gives trap capacities for a wide variety of applications.

Gas Turbines

A two-color booklet on gas turbines for pipe-line pumping has been made available by the General Electric Co. Designated as publication GEA-5530, the 16-page bulletin describes the features of the equipment, its application and operation. It is illustrated with photographs, line drawings and charts showing horsepower limits for various ambient temperatures. A chart showing components of the turbine and sketches showing typical installation buildings are included.

Controls and Instruments

A four-page bulletin lists and illustrates typical instruments manufactured by the Wheelco Instruments Co. These include models for measuring, controlling and recording temperature, voltage, current, static strains and other variables of industrial processing.

Reciprocating Pumps

The Aldrich Pump Co. has just released Data Sheet 67-A describing a six-in. stroke direct-flow pump. This two-color, eight-page bulletin gives details of design and construction including dimension and sectional drawings, performance data and pump specifications. Among the applications of these pumps are chemical handling, descaling and hydraulic systems and oil-field service.

Sump Pump

An eight-page bulletin, WQ-220, published by the Warren Steam Pump Co., Inc., covers Types VS and VN centrifugal sump pumps. These pumps are available in wet and dry-pit types with capacities to 2000 gpm and heads to 120 ft. The bulletin shows external and sectional views. It has dimension and selection tables and offers comment on various types of applications, including sewage and drainage service.

Packaged Power

A 24-page bulletin, GEA-5600, now available from the General Electric Co., outlines methods of obtaining electric power distribution equipment for quick industrial expansion. Use of packaged units in electrical systems simplifies plant engineering problems and insures quicker deliveries because these units are made up of standardized components which are factory assembled. The bulletin provides pictorial evidence of the ease of installation and flexibility of packaged switchgear and substations.

Acid Cleaning

Sumco Products, Inc., has prepared an illustrated brochure describing the procedure of acid washing of boilers and heat-exchange equipment. It contains technical data from a research report on an inhibitor used to protect boiler metal.

Glass Insulation

The Pittsburgh Corning Corp. has announced the availability of a 24-page booklet entitled "Foamglass Insulation for Piping and Process Equipment." The booklet discusses the advantages of Foamglass, listing its properties and typical data for cold, intermediate and hot applications. Details are shown for insulating vertical and horizontal tanks, ducts, removable covers and tank heads. Tables give sizes of standard blocks, beveled lags and standard curved segments.

Refractories

A 20-page booklet on Super Refractories has just been published by The Carborundum Co. By means of diagrams and charts it gives properties of these materials with respect to temperature, thermal capacity, chemical inertness, resistance to abrasion, and permeability to cold air. An interesting section of the bulletin pictures the various shapes in which the refractories are available.

Steam and Air Traps

W. H. Nicholson & Co. has prepared a 32-page catalog, No. 751, describing five types of thermostatic steam traps, two models of expansion steam traps, three kinds of weight-operated traps and three types of steam, air and gas separators. The catalog contains capacity tables, installation diagrams, and a section containing data for determining the proper size trap for specific applications.

This industrial "waterfall" shows the bore of the low-pressure element of a 120,000-kw G-E turbine being shrunk on the shaft after having been expanded by heating in an oven.